

CHEMICAL & METALLURGICAL ENGINEERING

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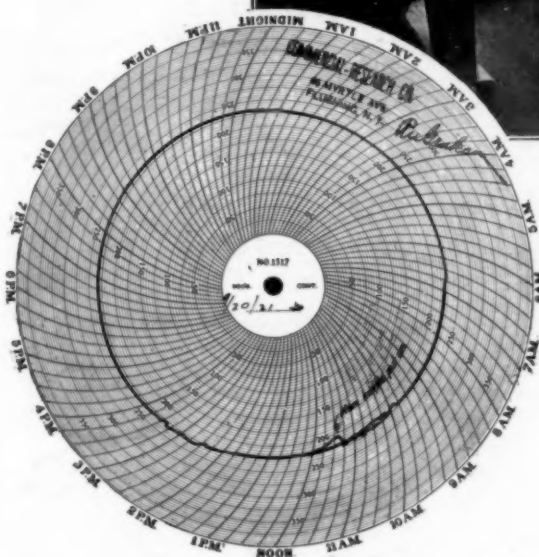
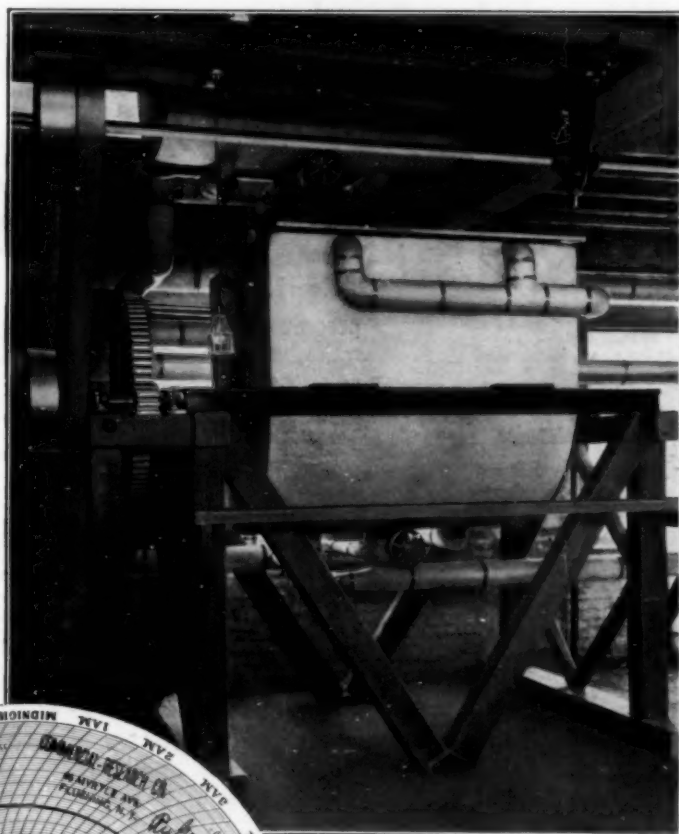


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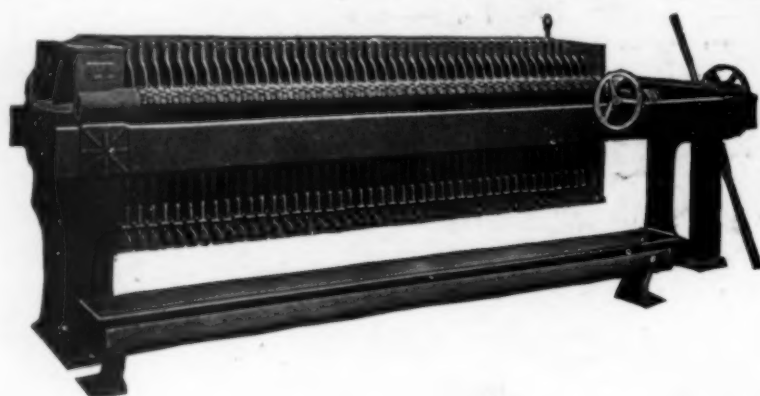
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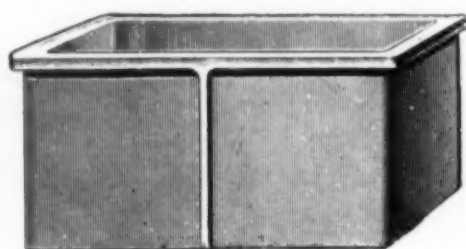
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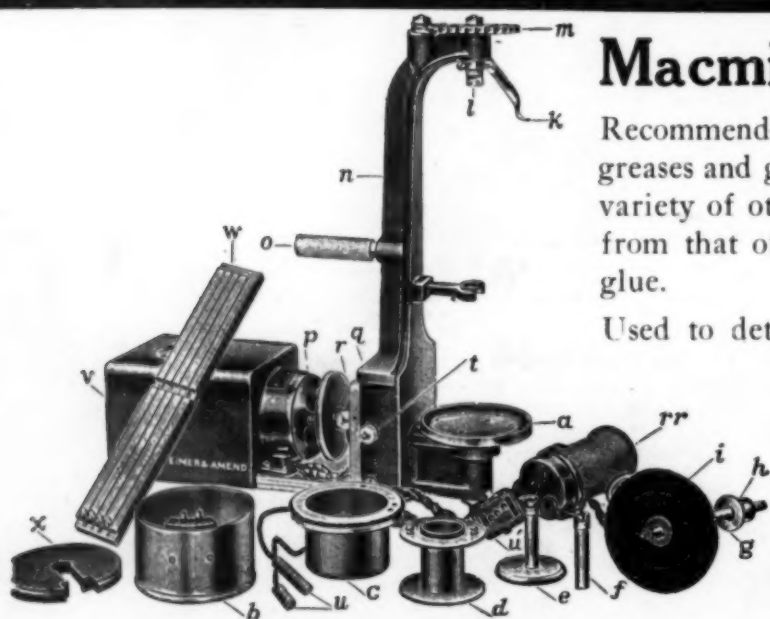
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To Regulate Trade Associations

THE dilemma in which trade associations find themselves as the result of the Hardwood decision continues to be the subject of much discussion. The most recent developments include the Hoover conference at Washington and the introduction, in Congress, of a bill by Senator EDGE placing such associations under the Federal Trade Commission and of a joint resolution, fathered by Senator EDGE and Representative McARTHUR, providing for a Congressional investigation.

"Business is entitled to know in definite terms what it may and may not do," declares the preamble of the proposed joint resolution. This declaration will strike a sympathetic chord in many a weary heart. For 50 years American business has been struggling to attain certainty of its legal status. Successively under the old common law doctrines, under the state anti-trust laws and under the federal Sherman act, business has been operating under the handicap of indefinite and negative restrictions. The process has been one in which business, denied definite positive guidance, has tentatively adopted in its tendency toward combination one legal form after another—the pool, the trust, the holding company, the merger—only to be checked and turned back by the Supreme Court, which has finally evolved that marvel of indefiniteness, the "rule of reason." The latest decisions have made it clear that combinations in restraint of trade cannot be erected under the guise of open-price associations. One more experiment tried and the check once more applied! Business now asks for a statement of what it can do.

The uncertainty which has been present has been costly in the past—much more costly than is ordinarily realized. If one were to attempt to devise a plan for dampening business enterprise, it would be difficult to evolve a more efficient implement than a threat of illegality.

It is not meant to infer that business should be left free to do anything it chooses. So long as competition is the force relied upon to protect consumers from high prices, it will be necessary to prevent by law combinations in restraint of trade. We merely point out that certainty as to what is legal and what is illegal would greatly simplify the problem of the business man. How can one proceed confidently so long as the rules of the game are undetermined and constantly shifting?

In this particular case, moreover, uncertainty is likely to be particularly costly. Unless positive guidance is given, the trade association movement will receive a blow which will prevent in large measure the performance of many functions which are highly useful in the economic process and quite free from objection on the grounds of restraint of trade. For the fact-finding function of the trade association is really a risk-elimination

function. If a business man can make his plans and decisions on the basis of fact and knowledge rather than guess and speculation, he can price more closely, eliminating the reserves and insurance premiums which inevitably accompany the conduct of business when surrounded by uncertainties. Trade associations now supply many valuable data and can be so developed as to supply more. Such data are essential to wise business decisions and will result in fewer losses to business men and lower prices to consumers.

The Edge bill may not be perfect. Senator EDGE does not pretend that it is. But certainly his proposals are steps in the right direction. It is possible to define fairly precisely the things which trade associations "may and may not do" and Congress owes it to the business community and to the country to make this clear.

Completing the Picture of Industry

IN FRESHMAN CHEMISTRY DAYS we learned that sulphuric acid was the great barometer of industry—in fact, of civilization itself. At that time, to be sure, our ideas on this subject were quite hazy, but since then we have come to realize that literally hundreds of industries are dependent on this important chemical. Fundamental materials such as copper, steel sheets, gasoline and fertilizers cannot be produced in needed quantities without sulphuric acid. This product lies at the very foundation of all our chemical industries. But all these things are well known even to the average layman and would not be worth the repeating here were it not for their bearing on a problem which is now confronting our industries.

When Mr. HOOVER became Secretary of Commerce one of his first ambitions was to organize a statistical service which would give the business men of the country a ready and accurate picture of industry. Such a picture meant current figures on the production and consumption of all the basic commodities of commerce. In a large measure Mr. HOOVER's plans have been successful. Manufacturers, consumers, trade associations and statistical bureaus have given fully of their information. But there has been one conspicuous and outstanding failure. The picture of industry has been complete except for one important element. Monthly figures are now published for iron and steel, coal, cotton and wool, corn and wheat, copper, petroleum—all these. But the great barometer of industry is lacking. The chemical industry, or rather one of its principal components, alone has refused to co-operate with the Commerce Department. We of the industry are entitled to know the reason for this refusal. We have been told that it is because the manufacturers fear that the consumers will use the information to the disadvantage of the producer. We suspect, however, that the reason

is this: The big fellow already has his own informational service and doesn't want to share it with the little fellow who can't afford such costly facilities.

There is another thing which any manufacturer who is refusing to give these figures should keep in mind. If enough of the other industries of the country insist that they have a real need for this information, the department is going to get it for them. A sympathetic Congress which has already shown its willingness to back up Mr. HOOVER's work with increased appropriations will not hesitate to enact legislation that will compel the giving of this information.

The acid makers whose selfish motives have already done damage to the good name of the chemical industries may yet be made to realize their short-sightedness.

How Much Petroleum Shall We Need in 1930?

STATISTICIANS have often projected the curve of petroleum consumption during late years to estimate the needs of the future. But J. E. POGUE has recently pointed out the fallacy of using such a trend curve alone for estimating the future demands for crude petroleum. He shows that any really sound basis of estimate must take into account the changes in industrial practice and allow for the modification of refinery yields in accordance with the indicated tendency of recent years.

In 1920 we used 531 million barrels of crude petroleum in the United States. This figure had been reached by increases of 10 per cent per year in the consumption during the previous decade. If such rates of compounding of demand should follow for another 10 years, the 1930 requirement for crude petroleum would be 1,260 million barrels, quite properly characterized as "a staggering volume."

But during recent years there has been a decreasing rate of addition to the number of motor vehicles for we are approaching somewhere near a point of saturation for this equipment. Moreover the yield of gasoline per barrel of crude oil has been greatly increased, particularly during the past 5 years. In 1916 the ratio of gasoline produced to crude oil consumed was 0.154. In 1918 the ratio had reached 0.206, and in 1919, 0.214. The 1920 figure showed a slight falling off, no doubt due to peculiar business conditions, but in 1921 the ratio was back again to 0.233.

On these assumptions POGUE projects the curve of crude petroleum requirements through the coming 10-year period and reaches very interesting conclusions. He demonstrates that the combined efforts of these factors is such that 585 million barrels of crude petroleum for 1925 and 580 million barrels for 1930 probably will be adequate to meet the demand for gasoline. These quantities are not much greater than the 1920 consumption. In other words, if the present tendencies of industry continue, we have already reached somewhere near the maximum demand for crude petroleum. The increased quantity of gasoline which is needed will be supplied, during the next few years at least, largely by increasing the yield of gasoline per barrel of crude refined. Thus improved technology will again help to meet and care for the changing economic conditions of the country.

Meanwhile, look out for benzene, alcohol, and the chap who some day soon will build up from lower hydrocarbons and end with "gasoline"!

The Shortest Distance Between Two Points

DID it never occur to you, especially when contemplating the layout and arrangement, or, better, lack of arrangement, in evidence in many manufacturing plants, that the meaning of the old axiom about a straight line had never really been accepted by most of us? Mankind seems to have a special fondness for devious ways and we never deviate more noticeably than in some of these same plants.

Should the inquiring mind attempt to ascertain the cause for this wavering path in industry, the reason most frequently given is that, in the hurry and stress of expansion, it has been impossible to arrange extensions of building and equipment in such a way that the process continues to flow in a straight line. This is undoubtedly true in a majority of cases; but there are also cases where the plant started off with a poor layout and has had it ever since.

Now the answer to this is: If you are stuck in the mud, take measures to get out. If the product of a plant is restricted and the cost of production is too high, if the workers are compelled to wait for materials and partly finished goods pile up in the open spaces and block the passages, if an undue proportion of the force is employed in just carting materials back and forth through the plant, then the owners of the plant, the managers and the technical staff should take immediate counsel among themselves to the end that these conditions may be relieved. The relief will undoubtedly lie in correcting the routing and may also, and in fact generally does, necessitate a change in the methods by which the materials are handled between various steps in the process.

One example of the results which can be obtained by merely straightening the flow of the goods through a plant has come to our notice recently and serves to show the results that follow correct routing alone, there having been no additional equipment utilized in this operation.

In this particular factory the manufacturing was all done in one building and the raw material used was light in weight. The process was rerouted so that the raw material—stored in the basement—was started in the course of manufacture on the top floor and one operation succeeded another until the finished goods were delivered at the shipping point on the ground floor without the line once crossing itself. The space and equipment were the same as had been utilized formerly, but the production increased about a fifth and the force of over 200 men was reduced by 20 who had formerly been employed in keeping the aisles clear and the machines supplied with material. A further advantage was that the inventory of goods in process was reduced to one-quarter of the amount formerly carried.

Another example: A pulp mill found it advantageous to relocate the chip house at a cost of over a hundred thousand dollars in order to make the flow of material straight enough to permit the use of conveyors through the plant and thereby cut down the man-handling of material to a minimum.

Many examples such as these could be cited; but they really form a small proportion of the industrial plants of the country and by far the greater number are still in a position to profit from an earnest contemplation of the straight line between the two points of receiving and shipping.

Aluminum for Engineering Structures

SEVERAL pages of a former issue were devoted to a digest of a very remarkable report by Messrs. ROSENHAIN, ARCHBUTT and HANSON on aluminum alloys—namely, the eleventh report to the Alloys Research Committee of the British Institution of Mechanical Engineers. In this issue a brief account of the most remarkable "Y" alloy is given.

Such excerpts give but an inkling of the material contained in the original report, which in turn is little more than a sketch of the results of 7 years' work by a staff numbering at times as high as thirty investigators, and commanding the unstinted resources of the British scientific laboratories. Truly, systematic researches into complex alloy systems have become most prodigious undertakings, far beyond the imagination of the sponsors of the program, started over 30 years ago. Yet it is well that the program was started so early. It is impossible to appraise the influence which the successive reports on steels, brasses, bronzes and aluminum alloys have had on modern technology—they are fundamental.

Aluminum alloys of high strength are not entirely new. The Germans have been using certain of them called "duralumin" for dirigibles since before the war. British and American firms have also been manufacturing duralumin for several years; shop practice is fairly well understood and many laboratory studies have been made on the somewhat bizarre occurrences during heat-treatment. Duralumin contains 3.75 per cent copper, 0.5 per cent magnesium, 0.65 per cent manganese. The present report extends our information by recording the development of "A" alloy, containing 3 per cent copper and 20 per cent zinc; "E" alloy, containing 2½ per cent copper, 20 per cent zinc and 0.5 per cent of both magnesium and manganese; and "Y," containing 4 per cent copper, 2 per cent nickel, 1.5 per cent magnesium.

These newer alloys have all been produced in quantity, and the peculiar combination of properties possessed by "Y" alloy should insure its extended use in industry. It is as light as aluminum, yet as strong as soft steel. It corrodes at an extremely low rate. It retains its strength at moderate temperatures, which fact, coupled with its high heat conductivity, should make it very valuable for engine cylinders and pistons. Furthermore, it has a high endurance limit; that is to say, "fatigue failures" after oft-repeated loadings do not occur until the impressed loads are well up toward the yield point. To appraise this particular property it should be remembered that it is more difficult to add 1,000 lb. to the endurance limit of a metal than it is to add 10,000 lb. to its tensile strength.

We need not expect light alloys of high strength to be adopted as quickly as the radio telephone. They are of course indispensable to aircraft, where weight is a very great consideration and dollars can be spent to save a single pound. Engineers and designers are only slowly realizing that weight is an important factor in all moving parts. But when they are able to convince manufacturers and owners that it is well to put more into a light car or engine and save on its subsequent operation, the aluminum alloys will still have to overcome the competition of heat-treated alloy steels, relatively cheap, very strong and reliable.

Although we can say with much assurance that light metals and alloy steels will form the large structures of the future, it would be vain speculation to attempt to

define their mutual relation. The best that scientists can do is to show that such things as high-strength alloys exist; metallurgists then discover how to procure the raw materials cheaply (and here much remains to be done for aluminum) and produce the alloys economically and uniformly. Engineers must then show us how to use these new tools of civilization—even to developing an entirely new technique of design.

Variations in Steel Demand

MEN who are anxious to stabilize business so that things would keep going at a steady pace all the time might well turn their attention to the steel trade. Either they would accomplish something for the industry or they would learn some of the difficulties involved in attempting to modify the actions of others.

There was quite a lot of talk last year about regulating the coal industry because it had become so seasonal in character, more coal being mined in winter and less in summer. It would be better to maintain uniform production, accumulating stocks in summer and drawing upon stocks in winter. If that is a good idea, how about a trade which instead of carrying stocks for purposes of equalization does just the reverse, increasing or decreasing stocks in such manner as to make the swings all the more violent?

That trade is the steel trade. Since the middle of March production of steel has been between three and four times as great as in July, 1921. The producers are not responsible, for they have simply been producing steel as it was bought from them. They cannot run on stock to any extent.

In the first 8 or 9 months of 1920 there was a very insistent demand for steel. Then demand fell off and in July, 1921, the mills were producing steel ingots at only 11,000,000 tons a year when their capacity was between 50,000,000 and 55,000,000 tons. Then production, which was dictated solely by orders received, rose rapidly, and the rate on April 1 was fully 35,000,000 tons.

Last summer stocks of steel in the hands of buyers and manufacturers of steel, not previously distributed, were being drawn upon. In recent weeks, on the other hand, the country has been increasing its stocks again.

It may be said that in times of heavy demand stocks are requisite and in times of light demand they are not. If that were true, some good work could be done by altering the condition. One might suppose that the stocks that stood as a barrier to mill demand in the summer of 1921 had been but recently accumulated. Many steel companies, however, report the curious experience of having had claims made upon them in the past few months against alleged defectives, when the records showed the steel had left the mill in the early months of 1920, before the apparent "scarcity" of steel had reached its height.

Before attempts are made to establish uniform production in industries whose product is actually consumed at varying rates, by establishing stock piles, it would be well to inquire into the cases where variations in demand are produced by variations in the amount of stock carried. A general study would probably show that the variations in demand upon producers of primary material are caused more by psychological than physical reasons, that the ups and downs in market demand are produced more by what men think than by the amount of actual consumption.

Readers' Views and Comments

Atomic Disintegration of Tungsten

To the Editor of Chemical & Metallurgical Engineering

SIR:—I regret that a delay has been necessary since the publication of Dalton M. Goetschius' comment in your issue of April 12 on the recent experiments of Clarence E. Irion and myself in exploding tungsten wires with the production of helium, and regret too that Mr. Goetschius did not have a more complete account of the work on which to base his comment.

Mr. Goetschius is quite correct in pointing out the analogy between the process of explosion such as we employed and the collisions of dark stars in interstellar space. Prof. W. A. Noyes of the University of Illinois has already pointed out in private correspondence that this is "a possible explanation of the sudden flaring up of stars which is sometimes seen," and Dr. J. A. Anderson, in the original paper describing the method used (*Astrophysical Journal*, vol. 51, p. 37, January, 1920), calculated that the same wire which by this method is impressed with 30 calories of energy would generate no less than 80,000 calories in falling from outer space into the sun, though it would probably not reach nearly so high a temperature because of the much longer time required.

The criticism that the production of mercury from tungsten involves an increase in atomic weight and is therefore a startling result which deserves "third degree" examination is also wholly correct, but is based on misinformation. It is regrettable that this work has received so much newspaper publicity and general comment in advance of the publication of the complete paper. Our carefully nurtured chemical publicity is, for once, working all too well. Not only are details ambiguously stated even by the careful reporter for *CHEMICAL & METALLURGICAL ENGINEERING* but atomic transmutation has been presented to the general public as established when mere decomposition is all that we can hope to have accomplished, and even that is based on preliminary work which cries for confirmation by others, who, fortunately, are already at work.

A brief report on this work will appear soon in the *Proceedings of the National Academy of Sciences* and a complete account is being sent to the *Journal of the American Chemical Society*. From these it will be evident that the helium spectrum was the only one unmistakably present in the gases formed by the high-temperature explosion. There was a background which seemed to be the banded spectrum of nitrogen and there was always a faint evidence of the strongest green line of mercury. This last was mentioned as part of the record, but we cannot but suppose that it was due to a minute backward diffusion of mercury vapor from the pumps used to exhaust the system, escaping the liquid air trap and even the cold charcoal bulb also used for evacuation. It does not justify theoretical speculation. The gas produced in the explosion of a 0.0005 mg. wire occupied slightly more than 1 c.c., on the average, which if it is all helium corresponds to nearly half the entire material of the wire. This should set at rest doubts on the ground of adsorbed

or included gases. A further point is that no hydrogen lines were ever observed, which is of interest because the atomic weight of tungsten, 184, is an exact multiple of the atomic weight of helium and in view of the fact that while Sir Ernest Rutherford was able to produce hydrogen in small quantities from B, N, F, Na, P and Al, whose atomic weights are not multiples of 4, he was not able to observe its formation from Li, Be, C, O, Mg, Si and S, which, except for the first two very small atoms, are multiples of the helium weight (*Phil. Mag.*, vol. 42, p. 809, 1921).

GERALD L. WENDT.

Chicago, Ill.

The Soldier Bonus and Editorial Independence

To the Editor of Chemical & Metallurgical Engineering

SIR:—On my way from Geneva to Basel I had the good fortune to meet Nobile Carlo Tommasi, administrator of the Lonza Co. of Basel. He is an engineer. When he learned that I am a member of your staff he took from his brief case the issue of *CHEM. & MET.* for March 1, 1922.

I glanced through the issue and read particularly the editorial on page 385 and the letters on page 390 relating to the soldier bonus. The next to the last paragraph of the letter signed by Messrs. Webster, Burrows and Wendel particularly attracted my attention on account of its reflection on members of your staff. I quote:

Speaking as one "having experience, if not authority," you mention that five members of your staff are opposed to the bonus. After your first editorial, it is doubtful if they would come out openly in favor of the measure and still hope to retain their positions.

Of course the imputation is thoroughly unwarranted. May I inform the gentlemen that I am not one of the five members of your staff who are opposed to the bonus and yet I am still in your organization and hope to be a part of it as long as my work is satisfactory? I may add also that I am a former member of the Canadian Expeditionary Forces.

J. S. NEGRU.

En Route, Geneva to Basel,
March 14, 1922.

EDITOR'S NOTE: Although we closed discussion on the bonus, we decided to accede to Mr. Negru's request to comment on this phase of the discussion. He is now making a trip through Central Europe for this magazine.

Fundamental Research on Corrosion

To the Editor of Chemical & Metallurgical Engineering

SIR:—It is very necessary that only the purest metals, those prepared with the most extreme care, be used in studying the fundamental facts underlying the problem of corrosion.

I notice one of the sheets of metal used by the Corrosion Committee of the British Institute of Metals¹ was reported as 99.97 per cent pure. That three-hundredths of a per cent may be very vital in the production of whatever corrosion takes place. Particularly there comes to my mind as an illustration some pure zinc which we had for a determination of melting point

¹See *CHEM. & MET. ENG.*, Feb. 15, 1922, vol. 26, p. 301.

standards. There were two samples, both of which analyzed as excessively pure materials; one, however, dissolved in ordinary hydrochloric acid immediately and the other only after several days' standing. The only chemical difference that could be found in those two pieces was six-thousandths of one per cent of iron.

It seems to me that in carrying out any corrosion experiments to find the fundamental facts one must start with metals of the greatest purity, otherwise the results may be, if not wholly, at least very greatly misleading.

GEORGE K. BURGESS.

Washington, D. C.

Causes of Corrosion in Brass

To the Editor of Chemical & Metallurgical Engineering

SIR:—One or two points brought out in the review of the findings of the Corrosion Committee, British Institution of Metals, published in your issue for Feb. 15, 1922, seem worthy of further comment.

I don't doubt for a moment that the accumulation of deposits in the inside of the condenser tubes is contributory to corrosion, but it does not explain the actual fact that out of a number of condenser tubes placed side by side in the same service, some fail in a few months and others last for years. Comparison of those tubes which have not failed with those companion tubes which do fail has not in my practice revealed any particular deposit on one tube that was absent in a companion tube. It seems as though there must be something more in it than merely the accumulation of deposits.

It does not seem to have been proved that dezincification does not actually occur, but is only apparent because the copper has built up out of the solution by plating back. Most condenser tubes are in service in which the circulating waters are going through very rapidly, and I think it would require considerably more proof than I have been able to find in this summary, that corrosion takes place not through dezincification but only by an apparent dezincification.

It seems to me that not enough attention has been paid to the crystal grain of the various brasses that have been used in the corrosion tests, or the condition of strain or anneal that may or may not be present, and which may be a contributing factor to the rapid deterioration of brass condenser tubes.

Washington, D. C.

ALLERTON S. CUSHMAN.

Effect of Composition of Brass on Corrosion

To the Editor of Chemical & Metallurgical Engineering

SIR:—From a microscopic examination of a large number of corroded condenser tubes I have come to the conclusion that quite different action may be expected, according to whether the brass is high in copper and shows only the alpha constituent, or whether it is lower in copper and has a duplex microstructure.

Considering the latter, of which Muntz metal is typical, it was observed that the beta constituent is the first to become attacked, with the result that a porous reddish material, which is practically all copper, is left behind. It would appear that the zinc has been preferentially removed. In some cases the entire tube becomes brittle and almost non-metallic from this cause. Corroded Muntz metal does not generally show pitting, but loses its original metallic properties and breaks into pieces when hammered.

On the other hand, brasses containing more than 65 per cent copper and which have an entire alpha struc-

ture usually dissolve away and become thinner when corroded, but do not become brittle. All of the brass tubes are likely to pit, but as a rule the pits in an alpha brass tube are clean, whereas the pits in a Muntz metal tube are usually filled with porous cement copper. Pitting seems to favor the bottom inside portion of the tube, where solutions may concentrate and foreign matters lodge. Condensers at the present time are usually built so that the tubes lie in a horizontal position. If the design were changed so that the tubes would be placed in a vertical position, there would be less tendency for solutions to concentrate and remain in contact with the metal when the condenser is permitted to drain or when it is shut off and the water in the tubes gradually evaporates and leaves behind concentrated corrosive solutions of salts.

PHILIP DAVIDSON.

Waterbury, Conn.

Electrolytic Concentration Cells as Accelerators of Corrosion

To the Editor of Chemical & Metallurgical Engineering

SIR:—Light may be thrown on the mechanism of corrosion of brass condenser tubes, discussed in your article "Results Achieved by the Corrosion Committee of the British Institution of Metals," by some work done recently by R. J. Mackay of the International Nickel Co. at the Mellon Institute.

We are all familiar with what we call galvanic corrosion of metals—that is, the accelerated corrosion which results from the presence of two dissimilar metals or two dissimilar portions of the same metals in electrolytic contact. The more electro-positive metal corrodes and the other metal forms the cathode and absorbs the hydrogen which is given off. Mr. Mackay has demonstrated an analogous type of corrosion which he calls corrosion by electrolytic concentration cells, using an idea quite well known to electrochemists, but, as far as I know, not hitherto recognized in its relation to corrosion.

If a uniform rod of metal is placed in contact with a solution which has a different concentration of the corroding ion at one point than at another, that portion of the rod in contact with the more concentrated part of the solution will form the cathode and the other portion will form the anode and the metal will go into solution there. In this manner it is possible to develop differences of voltage between different portions of a perfectly uniform piece of metal, amounting to as high as 0.2 volt, and Mr. Mackay has demonstrated that this condition does cause accelerating corrosion.

The demonstration was made particularly in the case of copper alloys in $\text{CuSO}_4:\text{H}_2\text{SO}_4$ solutions, but he has also shown that it is true of cells which are made up of a concentration of oxygen or air at one portion of the metal and a deficiency of the air or oxygen at another. He has found that such a condition can accelerate the rate of corrosion by as much as fifty times over that when the solution and the metal are uniform.

Could not some of the cases of pitting that have been noticed in the corrosion of condenser tubes be due to somewhat the same situation—namely, that the solution concentrates with respect to the corroding ion lodged upon the surface of the tube and in consequence sets up a concentration cell by which accelerated corrosion results?

PAUL D. MERICA.

Bayonne, N. J.

Thermal Problems of Petroleum Refining

Discussion of Petroleum-Refining Practice From the Combustion Engineer's Viewpoint—Adoption of Principles Proved in Other Process Industries Would Greatly Benefit Petroleum Industry—Secrecy and Use of Inbred Talent Is Destructive

By L. A. MEKLER
Consulting Engineer

OIL REFINING as it is practiced at present is of comparatively recent origin. The petroleum industry has made wonderful progress in the last few years, but due to the past abundance and relative cheapness of the raw material as compared with the finished product and the general tendency toward making rather than saving money the average refinery practice leaves much to be desired in efficiency. As a whole the industry does not utilize the scientific and engineering data developed and proved in similar operating phases of other industries. This is particularly true for the thermophysics of refining.

Each refining operation from the crude down to the paraffine or asphalt depends on the thermal treatment to which the material is subjected. The still is the starting point of all refinery operations, and can be compared to the digestive tract of the human body. The material leaving the still determines the subsequent treatment and the final as well as the intermediate products. On the other hand, since the fuel bill is one of the main items of production costs, the commercial merits of the process are mainly determined by the still. Yet in the average refinery the still proper is the least developed of all the units. In most cases it

desired treatment. These conditions are determined by the balance sheet of the operation, which must be the starting point in the design of a refinery unit.

Fig. 1 shows the thermal properties of paraffine hydrocarbons, plotted against molecular weight.¹ Most petroleum products are a mixture of these hydrocarbons, and since any mixture of members of a homologous series has the properties of the member having the average characteristics of the mixture, the thermal properties of any petroleum product can be determined with an accuracy sufficient for all practical purposes.

After the balance sheet is completed the conditions affecting the application of the heat to the oil must be fully considered.

WORKING TEMPERATURES

The working oil temperatures of straight (non-cracking) distillation are not over 450 deg. F. Since most of the distillation processes employ heat exchangers to preheat the incoming oil by the stored heat of the residue, the working range of a still is really between 150 and 450 deg. F. This is a slightly higher range than that of a boiler using a hot water heater. Yet principles of boiler design and operation cannot be successfully applied in their entirety to stills.

Water is a uniform liquid that does not break up chemically, unless the vapors are heated to 2,500 deg. C. Oil is a complex mixture, very susceptible to decomposition on heating. The thermal capacities of water and oil are also quite different. The total heat content of 1 lb. of saturated steam at 100 lb. pressure is in round figures 1,190 B.t.u., while that of oil is around 240. The specific heat of oil is less than half that of water. Therefore, when the still is operated as a boiler it is very easy to "force" the still and overheat the oil. In nine cases out of ten it is the local overheating that is responsible for carbon troubles, burnt-out bottoms, burst pipes, low yield, inferior products and many other things usually blamed either on the material treated or the subsequent operations.

TYPES OF STILLs

Since the working temperature range is the only difference between a straight and a cracking still, in matters of design the stills must be grouped with reference to their types rather than uses.

All stills can be divided into two main types: Cylindrical or conventional stills, and tube stills. Cylindrical stills are the left-overs of batch distillation. Inherently they cannot be efficient as a continuous apparatus, are troublesome in operation, have a tendency to burn out, need frequent cleaning and due to the

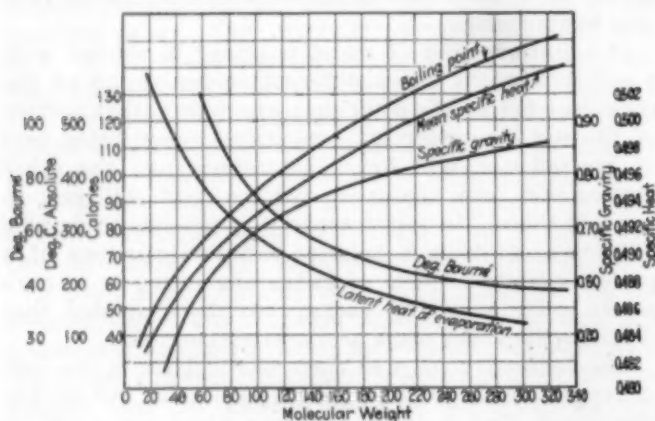


FIG. 1—PROPERTIES OF PARAFFINE HYDROCARBONS

is built on tradition, or on a pet superstition of the practical operator. The result is that, although a still is in its basic principles a boiler where the material is heated to vaporize the different constituents or cuts, the average thermal efficiency of most of the stills is around 20 per cent as compared with 75 to 80 per cent in the modern boiler.

High thermal efficiency is not the only requirement in still practice. The heat developed in the still must produce a certain thermochemical effect upon the oil, and since oil is very susceptible to thermal treatment, both the quantity and the quality of the heat must be such as strictly to meet the conditions favorable to the

¹Latent heat of vaporization after Trouton, Van't Hoff and Lagerlöf. Mean specific heat after Karawaleff.

large amount of oil heated simultaneously are a source of unnecessary hazards. The tube stills are of comparatively recent development but are today displacing the cylindrical type. The principles of design outlined in this article are, therefore, applicable mainly to tube stills.

The first requirement of a still is the absence of thermal shock to the oil—that is, a *gradual and even bringing up of the whole body of oil to the desired temperature, at a rate that does not exceed the thermal capacity of the oil and the heat conductivity of the container*. The rate of heat transfer $Q = \theta_m K$, where θ_m = mean temperature difference between the gases of combustion and the oil and K = coefficient of heat transfer.

$$\theta_m = \frac{\theta_i - \theta_f}{\log_e \frac{\theta_i}{\theta_f}}$$

where θ_i is the initial temperature difference and θ_f the final temperature difference between the gases of combustion and the oil. Therefore, θ_m will be larger the smaller is the ratio of $\theta_i : \theta_f$ —that is, when the initial and the final temperature differences are approaching each other. This is true when the hottest gases come in contact with the hottest oil, or the flows of the gases and the oil in the still are counter-current.

CHARACTER OF FLOW

Fig. 2 shows graphically the difference between concurrent and counter-current flows. T_{GI} is the temperature of the incoming gases; T_{GL} is the temperature of the gases leaving the furnace; T_{OI} is the temperature of the incoming oil and T_{OL} is the temperature of the oil leaving the furnace; θ_{m_i} is the mean temperature difference for counter-current flow and θ_{m_c} that for concurrent flow. By assuming $T_{GI} = 750$ deg. F. (probably ideal for topping); $T_{GL} = 450$ deg. F.; $T_{OI} = 200$ deg. F.; $T_{OL} = 400$ deg. F.; θ_{m_i} and θ_{m_c} will become 297 and 208 deg. F., respectively.

This means that the same still with the same temperatures of the gases of combustion and the oil will heat 42.5 per cent more with counter-current than with concurrent flow, and do it much more uniformly. With concurrent flow the rate of heating at the beginning is about $2\frac{1}{2}$ times as intensive as at the end and if the still does any heating at the end, the oil is overheated at the beginning of the cycle. That this is true in practice is evidenced by the fact that it is the lower tubes with the supposedly cooler oil that plug up or burn out in the average tube still.

The coefficient of heat transfer K depends mainly on the velocity of the fluids. The general formula¹ for two fluids both in motion is K (in calories per sq.m. per

$$\text{deg. C.}) = \frac{1}{\frac{1}{a} + \frac{1}{b} + N} \quad \text{where } a = 300 + 1,800\sqrt{v_1};$$

$b = 2 + 10\sqrt{v_2}$; v_1 and v_2 are the respective velocities of the colder and hotter fluids in m. per sec.; N , for iron $\frac{1}{4}$ -in. thick² = 0.0014.

Therefore, a still will have a much greater capacity if smaller tubes are used and if a large volume of low temperature gases, rather than a smaller volume of hotter gases, is passed through the heating chamber. Counter-current flow increases the relative velocity of

the fluids and permits the use of very low temperature gases. This is another argument in its favor. The use of smaller tubes will not only increase the heat transfer per square foot of heating surface but by increasing the heating surface per unit and cross-section will allow for the same amount of heat to be

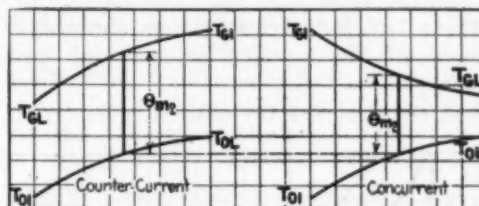


FIG. 2—CHARACTER OF FLOW AND RATE OF HEATING IN A COIL STILL

delivered to the oil at a lower mean temperature difference. As to the possibility of the smaller tubes plugging up, mild temperatures within the furnace thus made possible will eliminate the chances of overheating and remove the main cause of the trouble.

DROP IN GAS TEMPERATURES

Since counter-current flow and high velocities are essential for efficient application of heat, the coil still is the better of the two when compared to the header still, particularly if the coil still is overfired. It is a law of nature that cold gases travel down and hot gases go up. In an overfired furnace this natural tendency is assisting the proper flow of the gases of combustion. Even if it is assumed that the header still be fired at the exit header and baffled transversely so as to obtain a strictly counter-current flow of the oil and gases of combustion, the rate of heat transfer will not be as uniform as shown in Fig. 2, which is true for an overfired coil still. There is a sudden drop of temperature of the gases of combustion on both sides of the baffle. At the tubes in the center of the bundle with three baffles in the furnace this drop is one-quarter of the total drop of temperature of the gases. Fig. 3 shows this drop and the effect it has on the rate of heating of the oil.

The velocity of the oil in the header still is lower than in a coil still having the same number of tubes, since it provides a much larger section for the passage of oil than a coil made up of pipe of the same diameter.

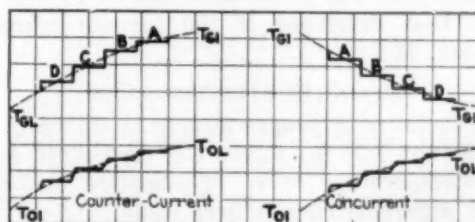


FIG. 3—CHARACTER OF FLOW AND RATE OF HEATING IN A HEADER STILL
Dotted lines are mean temperatures.

This means a lower heat transfer and therefore either a greater heating surface or higher furnace temperatures to produce the same results, which is another disadvantage of the header still, unless means are provided to recirculate the oil within the still proper, as is successfully done in at least one process.

Since proper application of heat depends closely on the correct generation of the heat, in designing a still

²Peclet.

¹Landolt-Börnstein "Tabellen."

full consideration must be given to the principles of efficient heat generation.

The greatest need of the refining industry at present is the introduction of combustion engineering which deals with these principles. The ceramic and the metallurgical industries owe no small part of their progress to the scientific application of combustion engineering, and to these two industries belongs the credit for the development of the modern science and practice of combustion.

The first requirement for efficient generation of heat

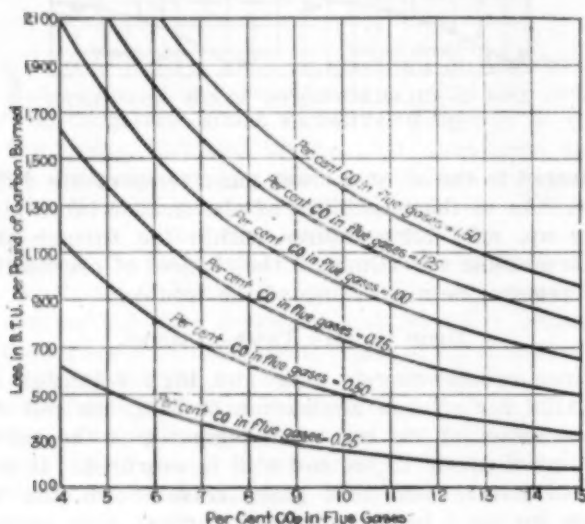


FIG. 4—LOSS OF HEAT DUE TO INCOMPLETE COMBUSTION

From "Steam, Its Generation and Use." Babcock & Wilcox Co.

is the proper proportioning and mixing of fuel and the air. Table I shows the theoretical amount of air necessary for the combustion of different fuels. Insufficient air will give incomplete combustion and a loss of efficiency. The loss of heat due to incomplete combustion is about 100 N B.t.u. per lb. of carbon content where N is the CO percentage of the combined CO and CO₂ gases. Fig. 4 shows the losses through incomplete combustion.

Excess of air is just as detrimental as lack of it. Fig. 5 shows the loss of heat in the flue gases due to excess air and the B.t.u. contents of the fuel and air mixture for different fuels at different excess coefficients. A 100 per cent excess (common practice in many refineries) will result in a loss of 25 per cent of the total heat developed if the furnace temperature is 1,000 deg. F.

MIXING COMBUSTION GASES

The importance of proper mixing is shown in curves CD and EF of Fig. 6. Curve CD represents in hours the time-temperature curve of complete oxidation of carbon at different temperatures when both carbon and oxygen are at rest and was obtained by heating charcoal in an atmosphere of oxygen. Curve EF shows in seconds the time necessary for complete combustion of carbon when the carbon and air are mixed and constantly agitated. The coefficient of agitation is determined by the size of the particles and the velocity of impact. Unity is the ideal as yet not obtained in practice even with gaseous fuel.

The best of gas and gasified oil burners have a coefficient of 0.90 to 0.95. Atomizing low-pressure oil-burners seldom exceed 0.80. High-pressure burners have a still smaller coefficient. The reason for this is

TABLE I—AIR REQUIRED FOR COMBUSTION OF DIFFERENT FUELS

Fuel	Heat Value B.t.u. Per Cu.Ft.	Theoretical Air Required, Cu. Ft. Per Cu.Ft.
Illuminating gas:		
Water gas.....	304	2.63
Carbureted water gas.....	589	6.84
Coal gas.....	608	6.00
Producer gas:		
Anthracite.....	125.7	1.053
Bituminous.....	125.0	1.120
Coke.....	126.3	0.985
Lignite.....	134	1.145
Oil.....	151	0.990
Peat.....	141	1.170
Wood.....	128.7	1.070
Blast-furnace gas.....	95.2	0.735
Coke oven gas.....	487	4.76
Natural gas (average).....	853	8.95
High hydrogen.....	834	8.66
Low hydrogen.....	870	9.20
Oil gas.....	542	4.94
Kerosene 0.863 sp.gr.....	Per Lb. 18,755	Per Lb. 189
Crude oil (Diesel) 0.877 sp.gr.....	18,636	187
Gasoline 0.704 sp.gr.....	18,500	193.5
Fuel oil 0.939 sp.gr.....	18,183	178

Note: For designing purposes when using liquid fuel assume 140,000 B.t.u. per gal. and an air consumption of 25 cu.ft. per minute per gal. per hour.

the great initial velocity of the mixture, which, due to the difference in size and specific gravity of the particles of the air and the oil, produces a difference in inertia of the particles as soon as the mixture leaves the nozzle, with the result that in cross-section the flame consists of rings of different chemical composition and different temperatures.

VELOCITY OF COMBUSTION GASES

Another important consideration is the velocity of gases of combustion both at the nozzle and after ignition. At the nozzle the velocity must be as close as possible to the velocity of propagation of flame, which is different for different fuels and is about 300 ft. per second for low-pressure gasified fuel. With the proper

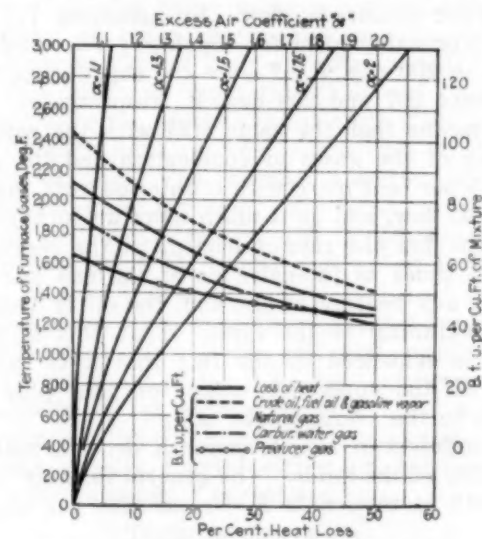


FIG. 5—EXCESS AIR AND FURNACE PERFORMANCE

After Ulbright & Torrance and Richardson.

nozzle velocity there will be no back firing, no flame pulsation and no hard smoky starting up of the furnace, so common in many oil-fired furnaces.

Velocity of the products of combustion within the combustion chamber determines the actual zone of combustion irrespective of the intentions of the designer, and should be such that complete combustion, as determined by the necessary time element from Fig. 6, occurs before the gases enter the zone of actual heating.

The last and the most important factor of efficient heat generation is the design of the combustion chamber proper. There is a certain fixed ratio between combustion space and the amount of fuel burned for each temperature, the ratio being more or less independent of the fuel burned. Fig. 7 shows the maximum actual

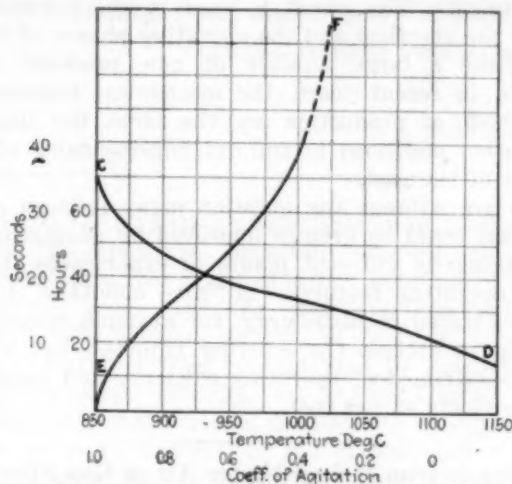


FIG. 6—IMPORTANCE OF PROPER MIXING
Curves after Reid & Wheeler and Le Chatelier.

obtainable temperatures for different ratios of B.t.u. per cubic foot of combustion space, as obtained in a certain furnace tested by the author. The curve is characteristic for all furnaces and depending on the ratio of the fixed losses through the combustion chamber (radiation, leakage) to the total heat developed is either raised or lowered parallel to itself.

RECIRCULATION

A new feature in combustion chamber design is recirculation of the gases of combustion after ignition. Although the least known, this feature is the most beneficial, since it accomplishes secondary mixing of the ignited gases and neutralizes the effects of concentric flame composition; it dilutes the atmosphere within the combustion chamber, and therefore eliminates the existence of hot spots in the path of the flame; the whole combustion chamber is thus converted into a mass

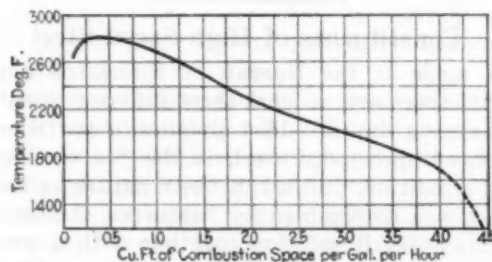


FIG. 7—COMBUSTION SPACE AND MAXIMUM OBTAINABLE TEMPERATURE

of infinitesimal centers of combustion, each point within the chamber as well as on the surface of the walls acting as a source of generation of heat energy. Recirculation further automatically regulates the time element and the velocity of products of combustion, by reducing the travel of gases in a straight line, helps to satisfy the time element necessary for complete combustion and the volumetric relations of the combustion chamber to produce the desired temperature. The recirculating feature permits transformation of

the high temperature heat of the fuel into heat of a temperature required for the distilling operation without the losses due to excess air which is commonly employed for the purpose.

Fig. 8 shows a combustion chamber having the recirculating feature incorporated in its design and the effect it has on the path of the gases. The amount of recirculation is determined by the distance of the recirculating baffle *B* from the wall by the size of the opening *O* in the baffle, by the nozzle velocity of the burner, by the velocity of the gases from the combustion into the heating chamber and the mean gas velocity through the complete furnace.

CORRECT STILL DESIGN

Fig. 9 shows the time temperature curve of an automatically controlled oil-fired heat-treating furnace built according to the principles of combustion engineering enumerated above. The maximum variation is ± 5 deg. F., with the minimum approaching ± 2.5 deg. F. The same results can be accomplished with a still if

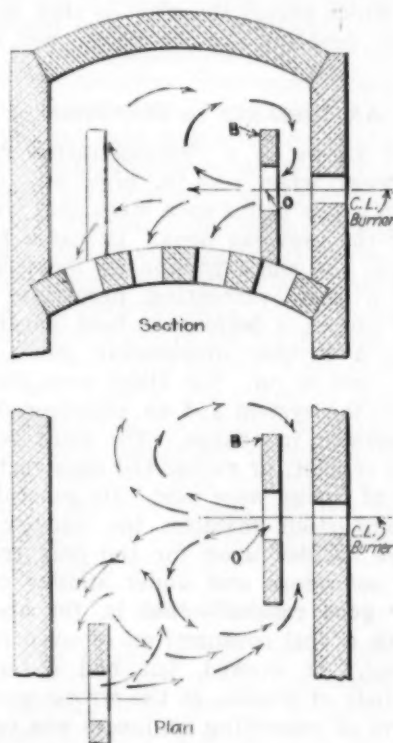


FIG. 8—COMBUSTION CHAMBER
WITH RECIRCULATING
FEATURE

in the design it is considered a delicate heating apparatus and not just so many bricks, a few buckstays and a burner, all assembled so as to produce "heat" and accommodate a container decided upon mostly on account of its having worked somewhere else. The results obtained in a scientifically designed still will in a very short time compensate for the extra care in designing and the additional cost of installation. This is particularly true for cracking stills.

There is a very delicate equilibrium between the straight and cracked phases of petroleum products depending on temperature and pressure. The aim of successful cracking is to make the transformation of the straight into the cracked phases as distinct and simultaneous as possible and all efforts are bent to separate the zone of heating from the zone of actual

cracking by comparatively sudden changes of temperature or pressure. All other conditions being equal, the more uniform is the heating the less are the chances for the zones to overlap and the less the possibility of premature cracking within the heating zone. It is the uneven heating within the cracker that is responsible for the fact that there are no truly continuous cracking processes, and that a run of 90 to 100 hours is quite an accomplishment. The average run is around 48

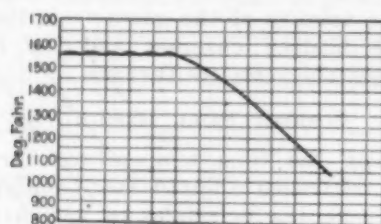


FIG. 9—TEMPERATURE CONTROL OF OIL-FIRED HEAT-TREATING FURNACE

hours, after which period the plant is shut down, often as far as the dephlegmator, to be cleaned of carbon deposits.

AN INSTANCE IN OPERATION

The writer knows of a "demonstration run" on a cracking process when a 4-in. pipe was completely plugged up in a few hours on a stock that was treated satisfactorily the previous week. It was a forced run for production. A small portion of the tube became hot, causing a local overheating, premature cracking, deposition of carbon, a decrease in heat transmission of that portion, a further overheating, more cracking, more carbon, and so on. Yet there were twelve good pyrometers on the system and an experienced and conscientious operator in charge. The fault was in the design of the cracker, or rather the construction, since no principles of design were used. Its general arrangement, the combustion chamber, the number and size of tubes were decided upon for the only reason that "it worked" somewhere else under similar conditions, with "pretty good results"—that is, for about 48 to 72 hours with a fuel consumption of over four times the theoretical. It worked, but had a tendency to develop all kinds of trouble at the wrong moment.

Later a firm of consulting engineers was called upon to develop a commercial unit for the process. The engineers worked under a handicap. They had to accept a certain "proved" (but from the combustion engineer's point of view questionable) construction of the cracker. They also had to take for granted certain "fundamental" laws of standard refinery practice. In spite of all this, by paying attention to the causes and not the manifestations of certain phenomena and by utilizing experience obtained in similar branches of other industries, they evolved a unit that made a continuous 18-day run with a fuel saving exceeding the best hopes of the customer.

CONCLUSION

Such success obtained teaches a lesson that should be taken into consideration by the refining industry. All process industries have many common fundamental operations, even if they are totally different in the finished product. Usually each of these operations is brought to a relatively high degree of perfection in some industry and the industries that make no secrets

of their accomplishments have the largest number of perfected operations to their credit.

Oil refining is as yet the most isolated of all the process industries. Except for the laboratory, where there are many chemists that have had experience in other fields, the refineries are too much dependent on inbred talent. The result is seen in the comparison between the chemical and the operating phases of refining. While a large number of new products were developed in recent years, the mechanical features of the methods of production are the same, the changes being rather additions to and not improvements of the practices of the past.

There are without any question many refinery operations that could be greatly improved by adaptation or by a pooling by different plants of experiences in the general operating features. A "give and take" policy as demonstrated in metallurgy, for example, would not only help to abolish the existing troubles, but would raise the standard of operating efficiency and result in better products at less cost.

Chicago, Ill.

Oxygen in Iron Melted Under Air or Gas Flame

A series of melts of electrolytic iron have been made at the Bureau of Standards under air in the induction furnace with additions of varying amounts of metallic calcium as a deoxidizing agent. The addition of calcium up to 0.2 per cent did not increase the soundness of the chilled cast ingots; the amount of oxygen (determined by the Ledebur method) in the ingots was practically the same throughout the series regardless of the amounts of calcium added. The average oxygen content of the calcium treated melts was approximately 0.23 per cent. Pure electrolytic iron melted under the same conditions contained 0.21 per cent oxygen. All the above melts were made in the open under still air. Electrolytic iron melted under a jet of air contained only slightly more oxygen than when melted under quiet air—namely, 0.24 per cent. Ingot iron melted under similar conditions under quiet air and under an air jet contained, respectively, 0.21 and 0.26 per cent oxygen. Ingot iron melted under the oxidizing flame of a gas blast-torch contained 0.26 per cent oxygen, the same as when melted under a jet of air.

Constituents of High-Speed Steel

Tests made at the Bureau of Standards appear to show that there are at least three different constituents present among the imbedded globules or particles in the specimen of high-speed steel, in the "as received from the mill condition," although their nature is unknown. This fact was determined by "sequence etchings" with (1) dilute NH_4OH solution together with a weak electric current, the specimen being made positive pole; (2) 2 per cent alcoholic solution of HNO_3 ; (3) boiling sodium picrate, and (4) Murakami's reagent (solution of potassium ferricyanide and sodium hydroxide) at boiling temperature.

"Sequence etching" means the etching with two or three reagents in successive order without any repolishing of the section between the etchings, and the taking of micrographs after each etching at the same spot in the microsection in order to note any changes in microstructure produced by the last etching as compared with that developed by the preceding etching reagent.

The System Furfural-Water*—I

A Study of Its Properties With Reference to Their Commercial Application in the Production of Furfural
—Boiling Point and Density of Furfural—Density of Furfural-Water Solutions—Solubility
Data—Boiling Point Curves—Temperature-Composition Diagram

BY GERALD H. MAINS

Color Investigation Laboratory, Bureau of Chemistry

IN THE METHODS of preparation of furfural given in the literature, pentosan- or pentose-containing substances are digested with dilute hydrochloric or sulphuric acids, and the distillate, consisting of a slightly acid aqueous solution of furfural, is collected. The furfural is then concentrated by extraction with ether or other solvents, or by distillation. Several authors note that furfural can be quite readily separated from water by distillation,¹ the greater part of the furfural coming over in the first portions of the distillate, from which, being only partly miscible with water, it can be readily separated. Some recent French patents provide for column distillation during the manufacture of furfural.² The author has found in the manufacture of furfural on a small factory scale that the separation of furfural from its aqueous solution by fractional distillation is a very short and effective method. There are, however, no published data, exact or otherwise, available on the relative compositions of distillate and solution, boiling point curves or condensation curves.

DISTILLATION OF PARTLY MISCIBLE LIQUIDS

When a mixture of two partly miscible liquids is distilled, as long as two layers are present the boiling point will remain constant and a distillate of constant composition will be formed. This mixture boils at a temperature below the boiling point of one of the components and often below that of either. When distillation has proceeded to the point where one of the layers disappears, the condition is one of a simple solution of one substance in another, and distillation continues with varying composition of distillate and rising temperature, until one of the components is entirely removed and the boiling point of the remaining component is reached.

The system furfural-water is an example of this class of partly miscible liquids. Furfural is somewhat soluble in water. When more furfural than will go into solution is added to water, two layers are formed, an upper water layer containing some furfural in solution and a lower, heavier furfural layer containing some water. Upon distilling a furfural-water mixture containing only a small proportion of the furfural layer, the boiling point will be slightly lower than that of water and the distillate will be of constant composition until the furfural layer has disappeared. The boiling point will then rise, and the concentration of furfural in the

liquid in the distilling flask will decrease more rapidly than in the distillate until practically pure water is left in the still. On the other hand, starting with a furfural-water mixture in which the furfural layer predominates, the concentration of water will be continually greater in the distillate than in the liquid in the still until the point is reached where for practical purposes it may be considered that all of the water has been separated and the residual liquid in the still consists of pure furfural.

It may be here pointed out that the liquid composed of furfural and water at room temperature is a solution of furfural in water when only a small amount of furfural is present, and a solution of water in furfural when only a small amount of water is present; and that between these two extremes two layers having a distinct boundary and differing from each other in composition are present. As the temperature is increased, the range of furfural-water concentrations throughout which the two layers occur becomes smaller, and at the same time the concentrations of the layers vary and approach each other. The liquid system furfural-water is then a solution over part of the range of composition, and over the remainder of the range is a mixture of two solutions, with no fundamental difference between them except concentration. For convenience, and with the theoretical justification already outlined, the liquid composed of furfural and water will be referred to throughout this paper as a solution.

EXPERIMENTAL

In order to study the system furfural-water, especially with respect to the corresponding compositions of solution and distillate (the solution in the flask being the liquid phase and the distillate the condensed vapor phase), an accurate method of determining the amount of furfural present was needed. The standard phloroglucin analytical method³ was tried, but it does not give results of sufficient accuracy for an investigation of this type. In a number of determinations on known solutions, in spite of all precautions, there was a variation of from 2 to 5 per cent from the true value. Several investigators have recognized the inaccuracies of the method and published data of others show variations of this order.⁴ For determinations of small amounts of pentosans in plant materials the method may be sufficiently accurate (far more so than the preliminary treatment to obtain the furfural), but it will not serve for accurate work on pure solutions. It is, moreover, very time-consuming. The precipitation of furfural as the phenylhydrazone is subject to the same objections.

Investigators who have studied the boiling point and condensation point curves of alcohol-water solutions

*Contribution from the Color Investigation Laboratory, U. S. Bureau of Chemistry, Washington, D. C. Published by permission of the Secretary of Agriculture.

¹Stenhouse, *Ann.*, vol. 35, p. 301 (1840); Hill, *Am. Chem. J.*, vol. 2, p. 33 (1881); Maquenne, *Ann. Chim. Phys.* (6), vol. 22, p. 76 (1891); Adams, Kamm and Marvel, *Univ. Ill. Bull.*, vol. 16, No. 43, p. 5 (1919); Monroe, K. P., *J. Ind. Eng. Chem.*, vol. 13, p. 133 (1921).

²Raisin, French Pat. 446,871, Dec. 17, 1912; Lederer, A. and E., French Pat. 464,608, March 26, 1914; Ricard, French Pat. 485,967, Feb. 26, 1918, and U. S. Pat. 1,322,054, Nov. 18, 1919.

³A. O. A. C. Methods (1920), p. 96.

⁴For example, Fraps, North Carolina Exp. Sta. Bull. 178 (1901); Dox and Plaisance, *J. Am. Chem. Soc.*, vol. 38, p. 2156 (1916).

have used density tables to determine composition, and in view of the fairly wide difference in density between furfural and water, this method gave promise of accuracy and simplicity. Schweser,¹ with an entirely different end in view, has determined the density of certain solutions of furfural and water at various temperatures. His data cover only three dilute solutions, and the density of his original furfural does not agree well enough with the determinations of the author to permit the use of Schweser's figures for the solutions. Accordingly a number of known solutions were prepared and the densities determined.

BOILING POINT OF FURFURAL

In any such determination of the densities of water solutions of a certain substance, the physical properties of the substance used, in this case furfural, are of the utmost importance. The furfural used in these experiments was made by digesting corn-cobs with sulphuric acid (30 per cent). The crude furfural was redistilled with the addition of 2 or 3 g. of sodium carbonate. A colorless product was obtained, and the fraction boiling between 159 and 161 deg. C. (uncorrected) was collected. Of this product 800 c.c. was redistilled, and the middle portion, 400 c.c., boiling constant within 0.1 deg. was collected.

The corrected boiling point of a sample of furfural made by this method, as read by an Anschütz thermometer suspended in the vapor and checked against one recently calibrated by the Bureau of Standards, was 161.8 deg. C. at 762.5 mm. (barometer fully corrected and checked against U. S. Weather Bureau barograph record). The vapor pressure curve for furfural (determined by H. Wales and the author, and to be published shortly) gives the correction value, 1 mm. equals approximately 0.05 deg. C. Using this value, the corrected boiling point at 760 mm. would be 161.7 deg. C.

A second lot of furfural which was used in a number of the experiments was found to have a boiling point of 161.8 deg. at 762.2 mm., or 161.7 deg. corrected to 760 mm. The corrected boiling points of other lots, as determined by an ordinary thermometer with long exposed stem and with consequent inaccuracies in the large stem correction, varied from 161.1 to 161.5 deg. C.

An especially pure sample was prepared as follows: To a portion of redistilled furfural obtained from corn-cobs was added saturated sodium bisulphite solution until the mixture became sirupy in consistency. It was then chilled. At approximately 15 deg. C. white needle-shaped crystals of the furfural sodium bisulphite addition compound separated out, the entire mass becoming nearly solid. The mother liquor was drained off on a suction filter and the crystals washed with ether and dried. The furfural was set free by adding a saturated solution of sodium carbonate. By fractional distillation a concentrated furfural-water solution was obtained and the furfural layer separated off. The wet furfural was then distilled, and, after the water had separated, the portion boiling within 0.1 deg. C. was collected. This sample was redistilled and the boiling point determined with an Anschütz thermometer (recently calibrated by the Bureau of Standards), totally immersed in the vapor and having the bulb covered with cotton batting to insure perfect condensation. The temperature rose rapidly to 161.7 deg. C. and remained constant during the distillation. The corrected barometer reading was 760.9 mm., so that the

corresponding temperature correction is less than 0.05 deg. These determinations indicate the true boiling point of pure furfural to be 161.7 deg. C. at 760 mm.

Of the boiling points of furfural previously given in the literature, ranging from 160 to 168 deg., only those of Schiff (160.5 to 160.7 deg. at 742 mm.) and Brühl² (161.4 to 161.8 deg. at 754.5 mm.) appear to have been obtained with any great degree of accuracy. Corrected to 760 mm., their results are: Schiff, 161.4 to 161.6 deg. C.; Brühl, 161.7 to 162.1 deg. C. It may be pointed out that with the small quantities used by them it would be difficult to purify the liquid by one distillation, and that in the case of Brühl's work the boiling point range indicates an appreciable impurity. The presence of a small amount of methyl furfural, a quite common impurity, would account for the higher boiling point.

DENSITY OF FURFURAL

The density of the freshly distilled sample of furfural, purified by transforming into the sodium bisulphite compound and recovering, was determined by means of a Sprengel type pycnometer. Because of the high heat conductivity and high coefficient of expansion of furfural the density values could be determined with accuracy only to the fourth place. The observed values corrected to vacuum standard were $D_{20}^v = 1.1598$ and $D_{25}^v = 1.1545$.

Using specific gravity bottles, as described hereafter, for the furfural-water solutions, density determinations were made on other lots of furfural at various intervals of time. Lot 21.1, from which the furfural-water solutions for the density determinations were made, was 22 days old at the time of making up the solutions. Its density values were $D_{20}^v = 1.1610$ and $D_{25}^v = 1.1556$. After standing 40 days in a cork-stoppered brown glass bottle the density was $D_{20}^v = 1.1631$, an increase of 0.0021. After standing 52 days, the value was $D_{20}^v = 1.1586$, an increase in density of 0.0030. This increase in density is probably due to a slow polymerization of

TABLE I—OBSERVED DENSITY OF FURFURAL-WATER SOLUTIONS

Per Cent Furfural by Wt.	Density (Referred to Water at 4 Deg. C.)		Per Cent Furfural by Wt.	Density (Referred to Water at 4 Deg. C.)	
	20 Deg. C.	25 Deg. C.		20 Deg. C.	25 Deg. C.
1.000	0.99823	0.99708	4.154	1.00589	1.00448
1.000	1.00009	0.99869	6.036	1.00953	1.00803
1.913	1.00165	1.00041	8.047	1.01308	1.01152

the furfural upon exposure to light and air. It is accompanied by a pronounced darkening in color, the liquid becoming a dark brown. Berthelot³ has described this polymerization and the resulting compound.

Since the density of furfural increases upon standing, the densities reported in the literature are of little value beyond the second decimal place, because the periods elapsing between the preparation of the samples and the determinations of their densities are not given. The density at 20° is given by Brühl² as 1.1594, and by Schweser¹ as 1.1593. Calculations from the formula of Jaeger and Kahn⁴ ($D = 1.1851 - 0.001176t + 0.00000096t^2$) give values at 20 deg. C. of 1.1620 and at 25 deg. C. of 1.1563. The criticism of the values of Brühl and Schweser is that the furfural used was not collected within a close enough boiling point range to

¹Schiff, R. Ann., vol. 220, p. 103 (1883).

²Brühl, J. W. Ann., vol. 235, p. 7 (1886).

³Berthelot and Rivals, Ann. Chim. Phys. (7), vol. 7, p. 35 (1896).

⁴Brühl, loc. cit.

⁵Schweser, loc. cit.

⁶Jaeger, F. M., and Kahn, J., Proc. Acad. Sci. Amsterdam, vol. 18, p. 617 (1915); J. Chem. Soc., vol. 110, II, p. 128 (1916).

⁷Schweser, Bull. Acad. Roy. Sci. (Cl. Sci.), 1911, p. 641.

be of absolute purity. Information as to the purity of the furfural used by Jaeger and Kahn is lacking. In order for density to serve as any criterion of the purity of furfural, the determination must be made on a freshly distilled sample.

DENSITY OF FURFURAL-WATER SOLUTIONS

The furfural used in making up the solutions was lot 21.1, $D_{4, \text{Vac.}}^{20} = 1.1610$, $D_{4, \text{Vac.}}^{25} = 1.1556$.¹² The furfural and water were weighed into tared flasks, and the densities of the resulting solutions determined by the use of 30 and 50 c.c. specific gravity bottles having ground-in thermometers. These thermometers were

TABLE II—COMPOSITION-DENSITY TABLES FOR FURFURAL-WATER SOLUTIONS

Per Cent Furfural by Wt.	Density (Referred to Water at 4 Deg. C.)		Per Cent Furfural by Wt.	Density (Referred to Water at 4 Deg. C.)	
	20 Deg. C.	25 Deg. C.		20 Deg. C.	25 Deg. C.
0.2	0.9982	0.9971	4.6	1.0068	1.0054
0.4	0.9986	0.9974	4.8	1.0072	1.0058
0.6	0.9990	0.9978	5.0	1.0075	1.0062
0.8	0.9993	0.9982	5.2	1.0079	1.0065
1.0	0.9997	0.9985	5.4	1.0083	1.0069
1.2	1.0001	0.9989	5.6	1.0086	1.0073
1.4	1.0005	0.9993	5.8	1.0090	1.0076
1.6	1.0008	0.9996	6.0	1.0094	1.0080
1.8	1.0012	1.0000	6.2	1.0098	1.0084
2.0	1.0016	1.0003	6.4	1.0101	1.0087
2.2	1.0020	1.0007	6.6	1.0105	1.0091
2.4	1.0023	1.0011	6.8	1.0109	1.0094
2.6	1.0027	1.0014	7.0	1.0113	1.0098
2.8	1.0031	1.0018	7.2	1.0116	1.0102
3.0	1.0034	1.0022	7.4	1.0120	1.0105
3.2	1.0038	1.0025	7.6	1.0124	1.0109
3.4	1.0042	1.0029	7.8	1.0127	1.0113
3.6	1.0046	1.0033	8.0	1.0131	1.0116
3.8	1.0049	1.0036	8.2	1.0135	1.0120
4.0	1.0053	1.0040	8.3*	1.0137	1.0122
4.2	1.0057	1.0044	8.4	.....	1.0124
4.4	1.0060	1.0047	8.6†	.....	1.0127
	1.0064	1.0051	.....	.....	.....

* Saturated solution of furfural in water at 20 deg. C.

† Saturated solution of furfural in water at 25 deg. C.

TABLE III—OBSERVED DATA ON MUTUAL SOLUBILITY OF FURFURAL AND WATER

Water Layer		Furfural Layer	
Temp., Deg. C.	Per Cent Furfural by Wt.	Temp., Deg. C.	Per Cent Furfural by Wt.
16	8.12	8	96.5
17.0	8.18	26.6	94.6
27	8.72	37	93.3
27.2	8.72	44	92.8
27.5	8.68	65	90.9
44	9.80	70	90.3
61	11.9	84	88.0
66	12.5	96	84.5
92	17.0	.....	.....

calibrated to 0.1 deg. C. against a thermometer recently calibrated by the Bureau of Standards. The densities (referred to water at 4 deg.) were determined at 20.0 and 25.0 deg. C., and were corrected to a vacuum standard. The value in each case is the mean of determinations made with two specific gravity bottles, except for the 6.036 per cent solution, where it represents the mean of six determinations, two with each of three specific gravity bottles. The probable error in density for this solution at 20 deg. is ± 0.00002 , and for 25 deg. is less than ± 0.00001 . The observed density values are given in Table I.

The composition of solution, expressed as percentage of furfural by weight, was plotted against the density on a large chart and the values were found to lie along a straight line. A variation of 0.01 per cent in furfural concentration produces a density change of nearly 0.00002, so that by using ordinary specific gravity

¹²These values are about 0.001 higher than the density values for freshly distilled furfural. This difference would cause an error in the dilute solutions, however, of only 0.00001 for the 1 per cent solutions, and of less than 0.0001 for the maximum concentration at saturation (8 to 9 per cent furfural at ordinary temperatures).

bottles and allowing a probable error of ± 0.00004 , the concentration of furfural can be determined within ± 0.02 per cent without taking any extraordinary precautions except that the room temperature must not exceed by any appreciable amount the temperature at which the density is determined. In Table II the densities read from the curve are given to the nearest 0.0001 for composition intervals of 0.2 per cent furfural.

SOLUBILITY DATA

Owing to the possibility of separating furfural from water by decantation of the two layers, solubility data at various temperatures become of importance. Rothmund¹³ has studied the mutual solubilities of furfural and water in relation to their critical solution point. Since his determinations were not made at constant pressure, but at the vapor pressure of the solution, and as data on the purity of the original furfural are not given, the solubility curves have been determined by the author for atmospheric pressure conditions.

The method followed was to place layers of furfural and water in a flask, bring to approximately the desired temperature, stopper the flask, shake violently 100 times, let the two layers separate, and pipette samples from each. The temperature was taken just as the shaking was completed, and except at room temperatures was read only to the nearest degree. The pipetted samples

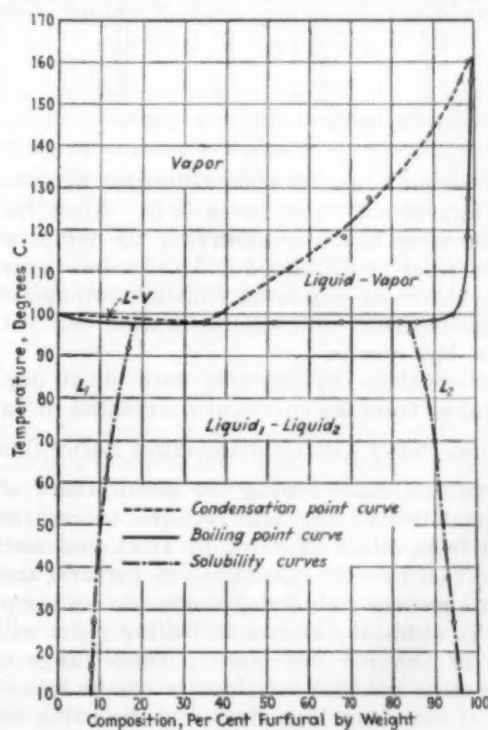


FIG. 1—TEMPERATURE-COMPOSITION DIAGRAM FOR THE SYSTEM FURFURAL-WATER

were necessarily taken as soon as the two layers had separated and before cooling had started any further separation. In determining the solubility in the aqueous layer it is important to have a very thorough shaking, on account of the slow rate of solution of furfural when near the saturation point. Globules of furfural may be present in the bottom of the solution when the solution is far from being saturated. Tests at room temperature indicated that the method adopted, violent shaking 100 times, was sufficient to obtain complete saturation.

¹³Rothmund, *Z. Phys. Chem.*, vol. 26, p. 454 (1898)

The concentration of furfural in the pipetted samples was determined by measuring the density of the original or diluted sample, and reading the percentage of furfural from the composition-density chart. In diluting concentrated solutions the aim was to get a solution of 6 to 8 per cent concentration, if possible, in order to avoid error by having a small multiplying factor.

The observed data are given in Table III. The agreement of the three determinations at room temperature indicates the degree of accuracy of the results.

The temperature-solubility curves for both aqueous and furfural layers, plotted from the observed values, are shown in Fig. 1. The values for the furfural layer run in fairly close agreement with Rothmund's data, reaching a maximum variation of 0.5 per cent below his values. The values determined for the water layer are, however, much higher than his, the difference increasing from 0.6 per cent at 10 deg. C. to 2.5 per cent at 65 deg. C., where his figure is 9.9 per cent, as compared with the present observation of 12.4 per cent. The difference decreases thereafter until at the boiling point they are within 0.5 per cent of each other again. There can be no question that all of the higher amount is in solution. The effect of pressure on solubility can

TABLE IV—MUTUAL SOLUBILITY OF FURFURAL AND WATER
(Atmospheric Pressure)

Temp., Deg. C.	Per Cent Furfural Water Layer	Per Cent Furfural Furfural Layer	Temp., Deg. C.	Per Cent Furfural Water Layer	Per Cent Furfural Furfural Layer
10	7.9	96.1	60	11.7	91.4
20	8.3	95.2	70	13.2	90.3
30	8.8	94.2	80	14.8	88.7
40	9.5	93.3	90	16.6	86.5
50	10.4	92.4	97.9*	18.4	84.1

* Boiling point of system when both layers are present.

scarcely account for the wide difference between Rothmund's figures and those given here. Since his determinations were made by observing the temperature at which the solution contained in small tubes turned from turbid to clear and vice versa without thorough shaking, it is possible that complete saturation did not exist, hence the low results.

For convenience the solubility data for 10 deg. intervals as taken from the curves are presented in Table IV.

BOILING POINT AND CONDENSATION POINT CURVES

Observations made during the manufacture of fairly large quantities of furfural and the concentration of furfural from dilute solutions by fractional distillation indicated that two-layer solutions of furfural and water boiled at approximately 2 deg. below the boiling point of water. To study the change in boiling point with composition of solution over such a small range of temperature could not give satisfactory results by using the process of distilling in a flask and recording the temperature with an ordinary thermometer. A method was devised in which two similar 500-c.c. distilling flasks were used, with Beckmann thermometers, graduated to 0.01 deg. C., inserted in each flask so that the scale began just above the cork stopper and the bulb was just below the side tube. In one of the flasks distilled water was slowly distilled, and, simultaneously and at the same approximate rate, the furfural-water solution under investigation was distilled in the other. The Beckmanns were calibrated against each other, using distilled water in each flask.

To determine the boiling point of a solution, the procedure was as follows: Furfural and water were weighed into the flask to make a solution of the required strength and a volume of 250 to 300 c.c. The Beckmann

was then inserted and the flask contents slowly heated until the first drops of distillate came over. As soon as free distillation was taking place a water-cooled weighed receiving flask was placed over the side tube, and the temperature read. The temperature was then read every minute for 8 minutes as a rule, and simultaneous readings were made of the temperature indicated by the Beckmann in the adjoining flask, in which distilled water was boiling under similar conditions. The average reading of the first Beckmann subtracted from that of the second, with the calibration correction and scale corrections considered, gave the depression of the boiling point of water caused by the furfural in solution. This subtracted from 100.00 deg. C. then gave the average boiling point of the solution at 760 mm. The distillate (15 to 20 g.) was weighed, diluted with a weighed volume of water, and the density determined in duplicate. From this the concentration of furfural in the distillate was calculated. The distilling flask and remaining contents were weighed, and the composition of the residue calculated. From these data the average composition of the solution during distillation was calculated. The concentration of the residual solution was also checked by density determination.

It was found that the distillate was several times as concentrated as the solution, and that above 20 per cent furfural, where two layers were present at the boiling point, the composition of the distillate was practically constant at 35 per cent furfural. A solution containing 34.7 per cent furfural boiled with a depression from the boiling point of water constant to 0.01 deg. for over 40 minutes, giving a distillate which showed the same

TABLE V—OBSERVED COMPOSITION AND BOILING POINTS OF FURFURAL-WATER SOLUTIONS

Average Comp. of Solution (Per Cent Furfural by Wt.)	*Average Comp. of Distillate (Per Cent Furfural by Wt.)	Depression From B.P. of Water, Deg. C.	Corrected Boiling Point at 760 mm., Deg. C.
0.79	7.6	0.33	99.67
1.37	10.1	0.55	99.45
2.54	16.2	0.73	99.27
3.54	22.0	1.13	98.87
5.06	25.5	1.52	98.48
6.94	28.4	1.67	98.33
10.2	32.8	1.96	98.04
15.4	34.6	2.09	97.91
21.1	34.6	2.09	97.91
30.0	34.7	2.10	97.90
34.7	35.0	2.10	97.90
52.0	35.0	2.07	97.93
73.0	35.0	2.10	97.90
82.2	35.4	2.10	97.90
86.0	35.2	2.04	97.96
90.2	35.7	1.7	98.3
94.8	38.3	0.2	99.8
98.3	68.5	.....	118.5
98.5	74.6	.....	127.8
99.3	96.6	.....	155.9
99.7	98.3	.....	160.1
99.95	99.7	.....	160.7
Pure Furfural	.....	.....	161.7

* Composition of distillate not exact owing to slight fractionation taking place in neck of flask.

analysis, 35.0 per cent furfural, for three different portions. The boiling point when both furfural and water layers are present is 97.90 deg. C. at 760 mm.

When the concentration of the furfural-water solution reaches 85 per cent furfural, the boiling point begins to rise and reaches 100 deg. at about 95 per cent furfural. After that it rises very rapidly, and the distillate contains a much larger proportion of water than the solution, until finally practically pure furfural is left in the flask, and the boiling point is above 160 deg. C. For these last determinations an ordinary thermometer displaced the Beckmann. The thermometer readings change rapidly during the determinations on solutions containing above 95 per cent furfural, hence the readings are probably not accurate to closer than a degree

TABLE VI—OBSERVED COMPOSITION OF SOLUTION AND DISTILLATE

(Fractionation Eliminated by Use of Heated Still Head)					
Run No.	Average Composition (Per Cent Furfural by Wt.)		Run No.	Average Composition (Per Cent Furfural by Wt.)	
	Solution	Distillate		Solution	Distillate
1 (c)	0.38	2.57	4 (b)	4.40	21.7
1 (b)	0.77	5.83	5 (c)	5.54	24.9
1 (a)	1.25	8.94	4 (a)	5.60	25.1
2 (c)	1.62	10.1	6 (b)	6.42	26.4
2 (b)	2.08	12.7	5 (b)	6.42	26.6
2 (a)	2.66	15.7	6 (a)	7.40	28.3
3 (b)	2.88	16.7	5 (a)	7.45	28.5
4 (c)	3.41	18.4	7	9.49	31.0
3 (a)	3.96	20.7	.....	.....	.....

except at the very end, where the distillate is practically pure furfural. As there is a 60 deg. temperature interval for a 5 per cent composition change, however, the relative accuracy is very satisfactory. The observed average temperatures and average compositions of solution and corresponding distillate are given in Table V.

The values in Table V have been plotted on a temperature-composition diagram, and curves drawn through the points give the boiling point and condensation point curves for the entire system. These are shown in Fig. 1, as well as the solubility curves before mentioned. Together they form the complete temperature-composition diagram at atmospheric pressure for the system furfural-water from 10 to 170 deg. C.

DISTILLATE-COMPOSITION VALUES DETERMINED WITH HEATED STILL HEAD

The method just described is especially well adapted to the determination of the boiling points of the solutions, since it provides for the condensing of small drops of the vapor upon the thermometer bulb. However, by insuring correct boiling points there is also brought about an inaccuracy in the composition of the distillate because of the partial condensation and fractionation which takes place in the upper portion of the still head.

TABLE VII—COMPOSITION OF SOLUTION, BOILING POINT, AND COMPOSITION OF DISTILLATE

(Pressure = 760 mm.)					
Per Cent Furfural by Wt. of Solution	Per Cent Furfural by Wt. of Distillate	Boiling Point, Deg. C.	Per Cent Furfural by Wt. of Solution	Per Cent Furfural by Wt. of Distillate	Boiling Point, Deg. C.
0.2	1.5	99.90	7.5	28.5	98.26
0.4	3.0	99.82	8.0	29.2	98.21
0.6	4.4	99.74	8.3	29.6	98.19
0.8	5.8	99.67	8.5	29.9	98.17
1.0	7.0	99.60	9.0	30.5	98.13
1.5	10.0	99.42	10.0	31.7	98.07
2.0	12.7	99.25	11.0	32.6	98.02
2.5	15.0	99.11	12.0	33.3	97.98
3.0	17.1	98.99	13.0	33.9	97.95
3.5	19.0	98.87	14.0	34.4	97.93
4.0	20.7	98.76	15.0	34.7	97.92
4.5	22.2	98.66	16.0	34.8	97.91
5.0	23.6	98.58	17.0	34.9	97.91
5.5	24.8	98.50	18.0	35.0	97.90
6.0	25.8	98.43	18.4†	35.0	97.90
6.5	26.8	98.37	18.4-84.1‡	35.0	97.90
7.0	27.7	98.31	.....	.....	.....

* Saturated solution of furfural in water at 20 deg. C.

† Saturated solution of furfural in water at the boiling point.

‡ Range over which both furfural and water layers are present.

Inasmuch as this method of determining distillate composition curves is open to some criticism,¹⁴ it was deemed advisable to use a method which would eliminate condensation errors.

For the dilute solution of furfural, which must be considered in the commercial production of furfural, the concentration of furfural in the distillate is so many times greater than that in the solution that it is important to obtain a very accurate composition curve.

These errors caused by partial condensation in the still head were eliminated in a second series of determi-

nations by heating the still head. A lead pipe was coiled around the neck of the distilling flask, the entire neck covered with tin foil, to bring uniform heating to all portions, and then covered with layers of asbestos and cloth. A vigorous current of steam passed through the coil kept the temperature of the still head at 100 deg. C., far enough above the boiling point of the solutions in question so that no condensation took place in the still head. As before, solutions of known strength were slowly distilled in the flask, and the distillate collected in

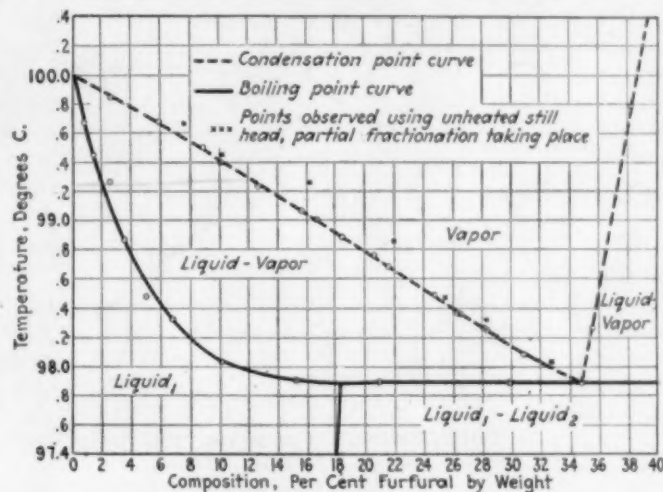


FIG. 2—TEMPERATURE-COMPOSITION DIAGRAM
Portion of Fig. 1 enlarged.

weighed, water-cooled receiving flasks. When about 20 g. of distillate had been collected, a second receiving flask was put in place and the distillation continued. The concentration of furfural in the distillate was determined from the density tables, and the average composition of the solution in the still calculated by the loss in weight. After two and sometimes three fractions of the distillate had been collected, the residual solution was weighed, and its composition checked by density determination.

With the higher concentrations of furfural not more than two samples could be collected from one run, owing to the error introduced by the tendency of furfural to polymerize after being heated for some time. Different runs gave determinations on distillate composition for the same solution composition varying only 0.2 per cent in a total of 26.5 per cent, or less than 1 part in 100. The greatest variation in values of residual solution in the flask, calculated from the original weight and the weight of distillate, and those determined by density was about 1 part in 200. The observed values of corresponding distillate and solution composition are given in Table VI. The notations (a), (b) and (c) in the column headed "Run No." indicate successive samples taken during the same run.

TEMPERATURE-COMPOSITION DIAGRAM FOR DILUTE SOLUTIONS

The data for the boiling point curve for dilute solutions were now plotted on a very much enlarged scale, and the values of distillate composition determined by the second method were plotted at the boiling point temperatures of the solutions with which they were in equilibrium. These boiling point and condensation point curves are shown in Fig. 2.

The distillate composition values, as determined by the first method where the still head was unheated and partial condensation took place, are indicated on the

¹⁴Cf. Lewis, *J. Ind. Eng. Chem.*, vol. 13, p. 169 (1921).

diagram by small crosses. It will be noted that these values are from 0.5 to 3 per cent too high. The values determined by the second method lie in a very smooth curve.

CORRESPONDING COMPOSITIONS OF SOLUTION AND DISTILLATE

The data from the curves of Fig. 2 are presented for convenience in Table VII, where, for every change of 0.5 per cent in composition of the dilute solutions, the

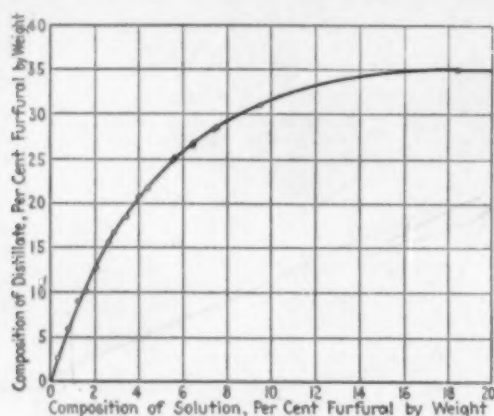


FIG. 3—CORRESPONDING COMPOSITION OF SOLUTION AND DISTILLATE

boiling point and the corresponding composition of distillate are given.

The great divergence of the boiling point and condensation point curves for this system shows why furfural can be so readily separated from water by fractional distillation. The relations between the compositions of the furfural-water solution and the distillate obtained from it are more clearly brought out by plotting the data from Table VI with composition of solution as abscissas and composition of distillate as ordinates. The solution-distillate composition diagram thus obtained is presented in Fig. 3.

Part II, dealing with the practical application of these data, will be published in a subsequent issue.

Domestic Potash Production in 1921

More than 18,200 short tons of crude potash salts containing 7,618 short tons of K_2O was produced in the United States in 1921 from domestic sources, according to the United States Geological Survey. This potash was produced at seventeen plants by fifteen companies, and about 79.5 per cent of it was extracted from natural brines. Three other companies produced considerable potash in 1921, but they have not yet returned their schedules. The annual production from domestic material was less in 1921 than in any other year since 1915.

Twenty-one plants made sales amounting to 8,907 short tons of crude material containing 3,895 short tons of K_2O , valued at point of shipment at \$383,218, and twenty-four plants reported stocks on hand amounting to 26,461 tons of crude material containing 10,348 short tons of K_2O . Sales and stocks on hand are reported by several companies that did not produce potash in 1921.

The only plants that reported continuous operation during the year were several that produce potash from the dusts of cement mills and blast furnaces. The inactivity of the fertilizer market and the low price of foreign potash are given as reasons for non-production.

More Efficient Oil Refinery Apparatus Required as Competition Increases

A study of the efficiency of oil refinery equipment is being conducted at the Petroleum Experiment Station of the Bureau of Mines, Bartlesville, Okla. The typical mid-continent "skimming plant" was erected at the time of flush production in some oil field adjacent to the location of the plant and, when completed, oil was at a comparatively low price and easy to obtain. In most cases no particular attention was paid to constructing an efficient plant for the reason that those interested in building refineries of this nature were anxious to get the plant running and obtain returns on their money as soon as possible. Recently conditions have changed to such an extent that a number of these refineries have been forced to shut down because of inability to obtain crude or because they were not able to manufacture products to compete with those turned out by the larger refineries. It is believed that by a careful study of these plants the Bureau of Mines can furnish advice as to the best methods for their operation and aid in preventing enormous wastes due to inefficient equipment.

Another investigation which is to be conducted at this station relates to methods of treating petroleum products. Most of the progressive refiners in the country realize that the methods of treating petroleum distillates have for the most part been handed down from one generation to another and that in many cases they are not satisfactory. They are of the opinion that work should be done to determine proper methods for treating distillates from the various types of crude, for at present a method for treating products from one type of crude may not be satisfactory for treating products of a certain other type. Also, the losses in treating are comparatively high, particularly in the case of the small refiners, who make use of open top agitators and as a result lose large amounts of the lighter fractions through evaporation.

Corrosion of Chromium Steels

It appears from a series of tests which the Bureau of Standards has carried out upon the corrosion of chromium steel that the behavior of the material when subjected to the acid test is not a sure criterion of its resistance to atmospheric corrosion.

Of all the alloys examined, a high nickel-chromium steel, invar, pure iron and medium carbon steel (very slowly cooled from a high temperature) were the most resistant to hydrochloric acid as measured by the loss of weight per unit area per day. High-chromium steels (for example, 13.70 per cent Cr, 0.29 per cent C) were found to be attacked by acid very much more readily. However, when the same specimens were subjected to a weathering test, consisting of a partial immersion in water and exposure to the air, the order of resistance was almost completely reversed. The high-chromium steels were the ones to withstand the treatment best, the low-chromium ones and the pure iron showing rust spots early in the test. The combination of both nickel and chromium appears to make the steel resistant to both acid and weather attack. In general, the steels which were quenched were found to resist corrosion better than the same material in the annealed state, but the differences found were much less than the differences resulting from composition changes, thus indicating that composition rather than treatment should receive primary consideration.

Y Alloy (Aluminum-Copper-Nickel-Magnesium)

**A Light Aluminum Alloy Having the Strength of Soft Steel and Good Ductility—Easy to Cast and Roll
—Retains Its Desirable Properties in Gas-Engine Parts Working at
250 Deg. C.—Immune From Season Cracking and Corrosion**

AS NOTED recently in these columns,¹ a report to the Alloys Research Committee of the British Institution of Mechanical Engineers on "Some Alloys of Aluminum" has been published, a volume of nearly 300 pages. It represents work of 8 years, much of it done under war conditions, involving the whole resources of the National Physical Laboratory. Among its most important disclosures are methods of fabricating a so-called "Y alloy" (containing about 4 per cent Cu, 2 per cent Ni, 1½ per cent Mg, and remainder Al), which in cast and heat-treated form develops strengths as high as 47,000 lb. per sq.in., or when rolled and heat-treated, 54,500 lb. per sq.in. with elongation of 24 per cent in 2 in.

It has been very desirable to discover a light alloy which would retain its high heat conductivity and strength up to at least 200 deg. C. to be used for pistons in airplane or other high-duty gas engines. A comparison with an alloy heretofore much used for this purpose is given in Table I, and shows how well the demand was met.

Many compositions were investigated before the Y alloy was hit upon. It was known that Al:Zn:Cu alloys (ranged in order of importance) were weak at 200 deg. C. Al:Cu alloys containing more than 4 per cent Cu were stiff and hard to extrude, and their tensile strength at 200 deg. C. was not more than 16,000 lb. per sq.in. Additions of 1 per cent manganese seemed to produce an alloy conforming to the desired specifications, but it possessed serious casting difficulties. Small additions of Fe, Mo, W, Cr and V were found to make the casting extremely brittle and porous; intermetallic compounds of high melting point solidified as a skeleton, from which drained the mother metal. After the advantage of combined Ni and Mg when added to an Al:Cu alloy had been found, the relatively high elongation discovered at 350 deg. C. led to successful experiments in rolling and forging of a series of alloys from which the new Y alloy was selected, and which were also found excellent mixtures for casting. Small variations in composition (± 0.75 per cent) do not materially impair the important qualities of Y alloy.

POURING AND HEAT-TREATING CASTINGS

Molds must properly provide risers of liquid metal to vent the considerable amount of gas evolved from Y alloy just before freezing, and to feed portions where "draws" or shrinkage cavities may be expected. (Total linear contraction is about 1.3 per cent.) Magnesium must be added just before pouring, in relatively large pieces of pure metal pushed below the liquid surface by a small perforated crucible, shown in Fig. 1. Experiments adding magnesium as an 80:20 Al:Mg alloy during melting produced unsound castings containing oxide inclusions. Nickel must be added to the mix as a "hardener," an Al:Ni alloy containing perhaps 20

per cent Ni. Y alloy castings seem to be unusually afflicted with minute holes ("pin-holes") appearing on machined surfaces, a defect which "need not be regarded as seriously deleterious to the casting."

Very important improvement in the physical properties of cast Y alloy may be had by heat-treatment, despite the negative effect of heat-treatment on cast duralumin. In order to approximate the strength of wrought material, chill castings (28,000 lb. per sq.in. ultimate) are given a 6-hour anneal at 530 deg. C., then quenched in boiling water and aged. This treat-

TABLE I—TESTS OF LIGHT ALLOYS AT HIGH TEMPERATURES

Temp., Deg. C.	88:12 Cu:Al			Y Alloy, Sand Cast			Y Alloy, Heat-Treated Rod	
	Ultimate	Elongation	Conductivity	Ultimate	Elongation	Conductivity	Ultimate	Elongation
20	30,000	7.2	....	24,000	1.8	....	54,500	24.0
100	....	....	....	....	....	....	50,000	21.6
150	....	....	....	....	....	....	48,000	23.9
200	14,000	5.0	....	....	....	....	14,000	24.0
250	9,000	6.0	....	23,000	1.0	....	....	....
300	6,300	6.0	0.37	20,000	1.6	0.37*	....	....
350	3,400	19.0	....	11,500	6.0	....	....	....

* Conductivity of gray cast iron at 300 deg. C. is 0.10.

ment, which is about 30 deg. higher than would be safe for duralumin, results in an ultimate strength of 47,000 lb. per sq.in. with 6.5 per cent elongation in 2 in. As shown by a comparison of Figs. 2 and 3, it has apparently caused the solution of some of the intergranular constituents, and a spheroidization of the remainder. Prolonged tempering of chill-cast Y alloy at 250 deg. C. reduces the strength to 22,000 lb. per sq.in. After quenching and aging, however, tempering at 250 deg. C. for 48 hours reduces the acquired strength no more than 10 per cent, and does not affect the elongation.

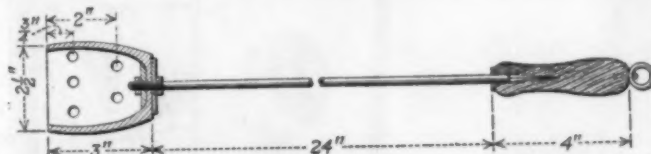


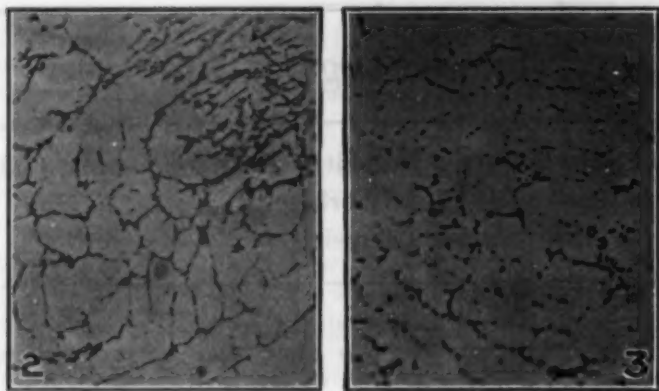
FIG. 1—PERFORATED CRUCIBLE FOR THE ADDITION OF MAGNESIUM TO LIGHT ALLOYS

Reheating to 500 deg. C. and slow cooling completely softens the alloy, and it undergoes no subsequent aging effect.

DEVELOPMENT OF Y ALLOY

The actual development of the wrought Y alloy is interesting, as an instance of successful synthesis. A preceding report to the Alloys Research Committee had indicated superior qualities in a 72:3:25 Al:Cu:Zn alloy. A series of low-copper Al-Zn alloys were therefore taken as a basis for experimentation, particular attention being given to the behavior during forging and rolling. It was soon found that 77:3:20 Al:Cu:

¹"New Aluminum Alloys of High Strength," CHEM. & MET. ENG., vol. 26, No. 15, p. 689, April 12, 1922.



FIGS. 2 AND 3

Fig. 2—Y alloy as cast. Unetched. $\times 150$.Fig. 3—Alloy shown in Fig. 2 annealed 6 hours at 530 deg. C. and quenched in cold water. Unetched. $\times 150$.

Zn (alloy "A") was the best of the lot, and complete information obtained on the proper way to roll rods, strip and very thin sheet. Magnesium (0.25 to 0.5 per cent) was next added, hoping that it would have the aging effect induced by its presence in duralumin. Manganese, a known hardener, was also introduced, and alloy "E" having the nominal composition: Cu 2.5 per cent, Zn 20.0, Mg 0.5, Mn 0.5, Fe not exceeding 0.2 per cent, Si not exceeding 0.2 per cent, was discovered, which was much stronger than anything of the sort hitherto known.

Both alloys "A" and "E," however, were deficient in strength at about 250 deg. C. It was thought that alloys containing Ni and Mg, which were not only strong but ductile at high temperatures, should be readily rolled and perhaps would retain their useful properties after working. It was immediately found that the addition of nickel, which was itself a hardener, markedly increased the ductility of alloys already so high in copper as to resist rolling. Comparison of tensile tests showed that 92½:4:2:1½ Al:Cu:Ni:Mg alloy was weakened only 10 per cent at 200 deg. C., and this mixture was then studied in detail as "Y" alloy.

MICROSTRUCTURE

Without entering into any detailed description of the microstructure, which indeed is not well understood as

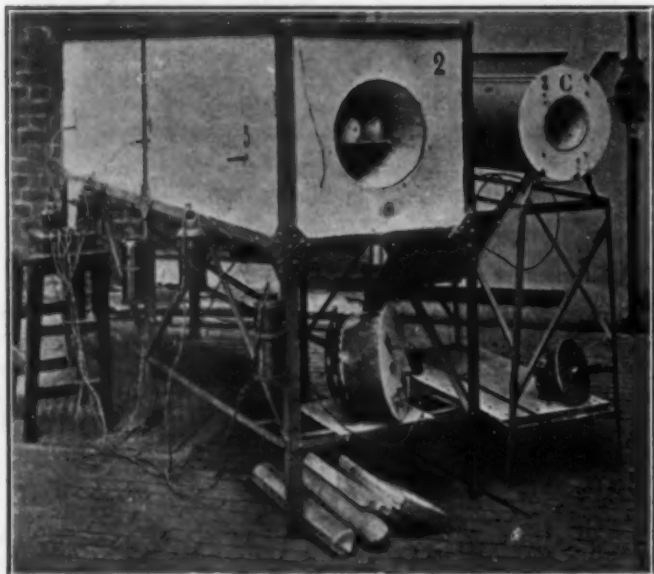


FIG. 4—ELECTRICALLY HEATED MUFFLE, 12-IN. DIAMETER, FOR HEATING LIGHT ALLOYS

yet, it has been found that when Y alloy has been annealed and is in equilibrium, no compound corresponding to the CuAl₃ of duralumin is in existence. Nickel, even when present to less than 2 per cent, seems to form a ternary compound with aluminum and copper, as well as a compound NiAl. Thermal studies show the absence of critical points below 554 deg. C. The liquidus is also considerably above 540 deg. C. Consequently the microstructure and rationale of heat-treatment is entirely different from that of duralumin.

EXPERIMENTAL PLANT

Alloys were melted without charcoal or flux, about 25 lb. at a time, in covered salamander crucibles placed in an oil-burning pit, and poured into one 3-in. chill-cast round billet, 19 in. long; three chill-cast rods, 1 in. round \times 7 in. long, and four shaped sand castings. Temperature was regulated by pyrometers, and no allowance was made for loss in melting.

Rolling was at first done in a commercial plant, but this was so unsatisfactory

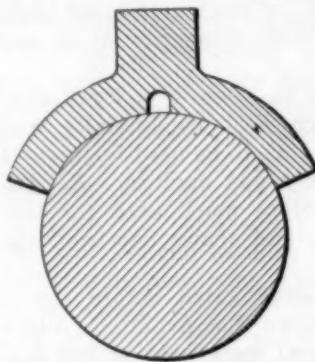


FIG. 5—ALUMINUM SADDLE FOR THERMOCOUPLE JUNCTION

that a two-high 15-in. mill was erected at the National Physical Laboratory. It is driven by a 60-hp. direct-current motor, using storage batteries for source of power. By regulating the voltage applied, linear velocity of the rolls can be varied from 50 ft. to 200 ft. per minute. A removable attachment consisting of a double row of gas burners playing upon the slowly rotating rolls imparted to them the heat which they acquire during ordinary mill practice.

Reheating and annealing was done in a large muffle shown in Fig. 4. It consists of a 12-in. steel pipe, 7 ft. long, covered outside with a layer of micanite and then wound with several sections of nichrome ribbon. The whole is bricked in with magnesia brick, and iron bound. Electrical heating coils are also provided for the ends, and a temperature gradient of ± 10 deg. C. is readily maintained at 400 deg. C., with a current consumption of 2 kw. This furnace has made over 1,000 heats in 5 years without any repairs or renewals whatever.

Temperature of the round billets was taken, without the necessity of drilling them for a thermocouple, by placing the aluminum saddle shown in Fig. 5 over them, and slipping the thermocouple junction in the groove between saddle and billet. When slabs were being heated, a spare slab, drilled for pyrometer, was charged in the furnace with the others.

CORRECT FORGING AND ROLLING PRACTICE

Difficulties with cracking during rolling, early encountered, were traced to surface defects in the cast billets. Preliminary forging seemed to close these surface imperfections somewhat, but billets free from surface defects were eventually made by pouring very slowly, in fact just rapidly enough to avoid cold shuts. For this purpose the molds (preheated to 100 deg. C.) were tilted to 45 deg., and the metal poured to match the solidification so that only a very shallow layer remained constantly liquid. Thus shrinkage cavities were

abolished. Surface and edge cracking occurring when rolling thin sheet in the experimental plant and later when much larger slabs were rolled in commercial practice was traced directly to surface defects in the slab—a slab which had been milled all over $\frac{1}{8}$ in. deep rolled perfectly. In the rolling mills various mechanical aids were tried, the most successful being the provision of a small V-shaped runner down the lower edge of the tilted mold. The tongue left on the slab is cut off before rolling starts.

Some of the alloys seemed to require a preliminary "breaking down" under a hammer. While chill-cast slabs of Y alloy $\frac{3}{8}$ in. thick will give no trouble in rolling to rods, it is desirable to forge it before rolling into sheets. With $1\frac{1}{2}$ -in. slabs, a reduction of 10 per cent should be given by forging in two heats at 240 deg. C. Then reheat the blanks to 480 deg. C. and roll to $\frac{1}{2}$ -in. plate in five or six passes. Subsequent rolling can then be done at high speed and heavy draft.

SUMMARY OF PHYSICAL PROPERTIES

Table II gives a summary of the tensile properties of rolled Y alloy rods and sheets after heat-treatment. Table I also contains physical properties at elevated temperatures of a $\frac{1}{2}$ -in. rolled rod, quenched from 480 deg. C. and aged 4 days. From this and a comparison of its strength in the rolled condition given in Table II

TABLE II—SUMMARY OF TENSILE TESTS ON ROLLED Y ALLOY 4

Material	Condition	Elastic Limit	Yield Point	Ultimate	Reduction of Area	Elongation in 2 In.
$\frac{1}{2}$ -in. rod	Hot-rolled	.....	26,900	39,400	30.0	20.0
	Quenched from 530 deg. C. and aged	17,200	34,500	54,000	33.0	23.0
	Cold-rolled from $1\frac{1}{2}$ -in. hot-rolled, quenched from 530 deg. C. and aged	17,200	34,000	54,100	34.0	25.0
$\frac{1}{2}$ -in. rod	Cold-rolled from $\frac{1}{2}$ -in. hot-rolled, quenched from 520 deg. C. and aged	.....	33,400	51,200	31.0	26.0
	Hot-rolled; quenched from 480 deg. C., aged	.....	36,000	52,000	.....	19.0
	Hot-rolled; quenched from 530 deg. C., aged	.....	38,500	58,200	.....	19.0
0.05-in. sheet	Cold-rolled; quenched from 530 deg. C., aged	22,000	46,500	60,200	.....	17.0
	Cold-rolled; quenched from 530 deg. C., aged	.....	47,000	62,800	.....	17.0

it appears that prolonged heating to something over 200 deg. C. will remove the hardening effect. On the other hand, test-pieces held 100 hours at 150 deg. C. and tested at that temperature give the same tensile results as though the heating had endured but 30 minutes. Wohler fatigue tests on tubular test-pieces at 150 deg. C. (designed to show the expected endurance as connecting rods) gave a safe range of alternating stresses of $\pm 18,500$ lb. per sq.in., wherein the metal may be expected to endure indefinitely, as compared to $\pm 23,000$ lb. per sq.in. at room temperature. Table II also shows that an increased strength and unimpaired ductility may be had by quenching in water from 530 deg. C.—about 50 deg. higher than the proper temperature for duralumin. Even higher strengths may be had by cold-rolling $\frac{1}{2}$ -in. plate, reducing thickness 10 per cent in each stage, and separating stages by a quenching from 480 deg. C. Sheet so prepared 0.05 in. thick, after quenching from 530 deg. C. in boiling water, shows an ultimate strength of 58,000 to 61,000 lb. per sq.in., and elongation of 16 to 18 per cent in 2 in.

*Rolls must be kept well lubricated to prevent them seizing and splitting the hot metal.

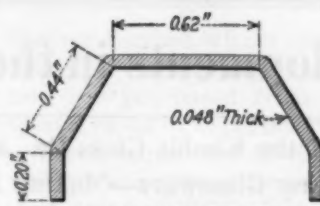


FIG. 6—ROLLED CHANNEL FOR COMPRESSION MEMBER

A channel, shown in Fig. 6, was made in a bending machine from heat-treated rolled strip, and cut into 6-in. lengths with squared ends. This was seated on ball centers, and tested in compression. A buckling stress of 30,600 lb. per sq.in. was devel-

oped by Y alloy, a figure 13 per cent higher than duralumin.

CORROSION RESISTANCE

Y alloy is as light as any of the stronger aluminum alloys which have yet been produced, and is distinctly superior to most in the ease of manufacture. Its great superiority lies in a very remarkable resistance to corrosion, and its entire immunity from intercrystalline cracking under prolonged loading (season cracking). Without presenting details—since corrosion investigations are in the hands of the Institute of Metals committee—the eleventh alloys research report notes that both in the cast and rolled condition the Y alloy possesses considerably better powers of resisting corrosion, even when immersed in sea water, than the other high-strength aluminum alloys.

War Gases to Be Used for Extermination of Pests

Experiments on the use of poison gases for exterminating obnoxious birds, rodents and insects will be undertaken this fall, when the Biological Survey, in co-operation with the Chemical Warfare Service, will make a trial of the method on blackbirds in the Imperial Valley of California. In that region these birds are said to do at least \$50,000 worth of damage to the milo crop each year. Because of their feeding habits it is impossible to destroy these birds with poisoned baits, but, as they roost on the reeds in the marshes, it is thought that they can be killed by a gas cloud at night when the wind is favorable. The blackbirds are migratory and return to the same places year after year. It is thought that a big killing in a certain locality will probably free it of the pests for many years. A few other birds in the blackbird-infested marshes will be killed at the same time, but the department believes that these local birds will soon reach their normal numbers again.

Arrangements also are being made by the Biological Survey with the Chemical Warfare Service for investigating the possibility of using poison gases on such burrowing rodents as rats, prairie dogs, ground squirrels and woodchucks. Tests on pocket gophers and ground squirrels by these two co-operating branches of the government in California show that chlorine may be used with good results if handled properly. The Chemical Warfare Service used phosgene on rats in Porto Rico with promising results. Some of these war gases will be compared with carbon bisulphide for the killing of woodchucks and other rodents in their burrows.

Entomologists of the department have already worked in co-operation with the War Department in testing various gases on insect pests of growing plants and those that infest stored grain, but it has not yet been found advisable to recommend anything to take the place of hydrocyanic-acid gas or carbon bisulphide.

New Developments in the American Glass Industry

Description of the Plant of the Kimble Glass Co., at Vineland, New Jersey—Development of Automatic Machinery for Making Glassware—Making Precision Scientific Apparatus in the United States—Development of a Force of Skilled Glassworkers

By G. L. MONTGOMERY

SHORTLY after the outbreak of the World War in 1914 it became extremely difficult to obtain certain articles for which the United States had been almost entirely dependent upon imports from Europe. As a direct result of this condition the more enterprising among our manufacturers began to take steps toward developing the manufacture of these articles in this country. One of the most important items which we were unable to get was technical glassware—that used by chemists, metallurgists, biologists, physicians, pharmacists and other scientists, and also by the United States Bureau of Standards. Small amounts of this product had been previously manufactured in this country; but production was not generally on a commercial scale, and the greater part of our demands had been filled by imports from the Central Powers.

One of the plants which undertook to stop this gap in our commercial structure was the Kimble Glass Co., of Vineland, N. J. Founded in 1907, this company had taken over a small, single-furnace plant of about 2½ tons daily capacity and 20,000 sq.ft. of floor area. In 1910 expansion had commenced and at the outbreak of the war the floor space had quadrupled and the plant was turning out a line comprising rods, tubes, homeopathic vials, test tubes, Babcock milk test bottles, and various other articles. At that time all processes both in the hot and cold metal plants were hand processes. The products were confined to such as could be made in quantity by hand and did not call for highly trained workers and technical control.

DEVELOPING THE MANUFACTURE OF GLASS BY AUTOMATIC MACHINERY

In the manufacture of the Babcock milk test bottle this company had proved its ability to produce an accurately graduated article. In the emergency the government requested the company to go more extensively into the manufacture of graduated ware. The developing of a graduating department was immediately commenced. At the present time this department has over one hundred skilled operatives and turns out all types of precision graduated glassware, including apparatus complying with the specifications of the Bureau of Standards. Along with this development has also come the blowing and finishing of the complicated pieces of testing and surgical glassware formerly produced only in Austria and Germany. It was necessary to train the men for these new processes, as there were at the time no men available with sufficient skill. Those who had been engaged in the normal operation of the plant were trained along the new lines; but the shortage of labor prevalent during the period made it difficult to obtain workers to fill their places. From this has grown the manufacture in quantity on automatic machines of homeopathic vials, test tubes and other articles made from tubing.

The machines to perform these last-named operations were experimentally worked out in the plant, and have all been designed and patented, and are now manufactured there. The advantages following the use of these machines consist in larger output with fewer operatives, a uniform and high-quality product, and the provision of a staple quantity line in constant demand to back up the production of the varied line of special ware for which the demand may fluctuate.

FACTORS GOVERNING LOCATION IN VINELAND

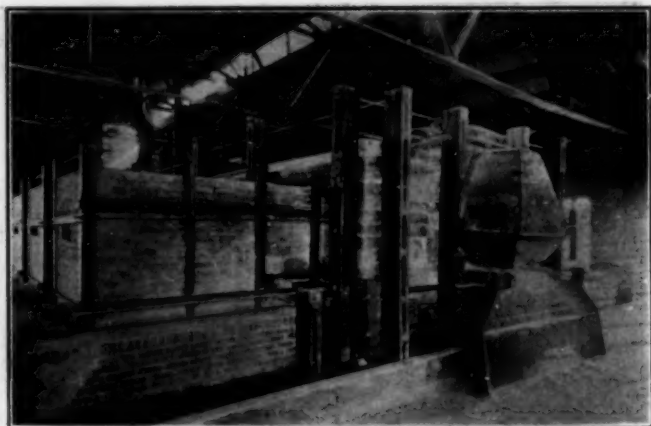
The town of Vineland is in the heart of the New Jersey glass sand district, and proximity to the source of the most important raw material and accessibility to the Eastern market and the ports of New York and Philadelphia were the factors determining the location at this point. About 900 tons of the glass sand are used annually. It is mined and washed at the company's mine, located near the plant, and is about 99.8 per cent SiO_2 . The other materials used comprise yearly amounts of about 2,400 tons of gas coal, 2,800 tons of steam coal, 300 tons of soda ash, 150 tons of lime, and smaller quantities of coke, red lead, litharge, hydrofluoric acid, wax and various other commodities. These are brought in on the Central Railroad of New Jersey, which has two tracks leading into the plant. The Pennsylvania Railroad is also close by.

HOW THE PLANT IS HOUSED

The buildings of the plant are all one-story, reinforced concrete and brick buildings with wood deck roofs on steel trusses, except the structures containing the glass-blowing and machine departments and that housing the office, graduating and lamp departments. The glass-blowing and machine departments are one-story steel frame buildings with corrugated asbestos and brick veneer walls and asbestos roofs. The office, graduating and lamp departments are in a two-story mill type building. The total floor area of the plant is approximately 130,000 sq.ft., of which the raw material and batch building occupies 3,500 sq.ft., the hot metal plant about 30,000, the cold metal plant about 39,000, packing and warehouse about 43,000, power and heating 6,000, machine shop 3,600, laboratory 1,500 and office 1,500.

HANDLING THE RAW MATERIAL

The raw materials for glass are brought to the plant by rail and delivered to the batch house. Due to the comparatively small quantity of these materials used, large storage space is not provided and the materials are stored in small piles on the floor. The batches are mixed here by hand and placed on large barrows, 1,000 lb. to the batch. It is essential that the batches be in accordance with an exact formula and the necessary care and attention can be had only by hand mixing.



TANK FURNACE OF 20 TONS DAILY CAPACITY

From the batch house the barrows are wheeled to either the glass factory or the tube machine building, which constitute the hot metal department.

THE FIRST PROCESS IN THE MAKING OF SCIENTIFIC GLASSWARE

The glass factory is the department in which the shapes used in the manufacture of scientific apparatus are blown. The equipment comprises a furnace for closed pots having a daily capacity of five 1,000-lb. pots, a "glory hole" and two hand-operated lehrs. Connected with the building, one on each side of the blowing floor, are two pot arch furnaces.

The glass to be annealed is placed in and removed from the lehrs by hand. This method is used in preference to mechanically operated lehrs because of the varied product, each different shape requiring a different amount of annealing. The pot furnaces are heated by direct coal fire underneath, being fed from the basement level by coal supplied from a trestle on the adjacent railroad siding. The lehrs are heated by oil, the burners being placed beneath the lehrs and fed from an oil supply in two nearby 10,000-gal. storage tanks. This means of heating the lehrs gives a better temperature control than is available by using coal or gas. Both the pot furnace and the lehrs are provided with indicating pyrometers in the glass factory and recording pyrometers in the plant laboratory, enabling both the factory foreman and the plant chemist to keep the temperatures under continual observation.

A tank furnace is at present being constructed in this building with a daily capacity of 5 tons for use in making resistance ware—i.e., ware which can be subjected to extreme variations in temperature without breakage. This tank is of the low arch type and will be heated by oil burned in pressure burners. The air necessary for combustion will be heated in a recuperator, situated on the same floor level and at the rear of the tank. A novel feature of this tank is that the charging of the batch and the extraction of the melt are both accomplished from the same side. This is possible due to the substitution of oil firing for the usual gas firing and the consequent elimination of flues on the sides of the tank. As a result it has been possible to place the tank in such a way as to conserve more floor space for blowing than is possible in the average installation.

This department also contains two experimental furnaces for the development of new types of glass. One of these is a tank furnace called a day furnace and holding sufficient melt for a one-day run. The other

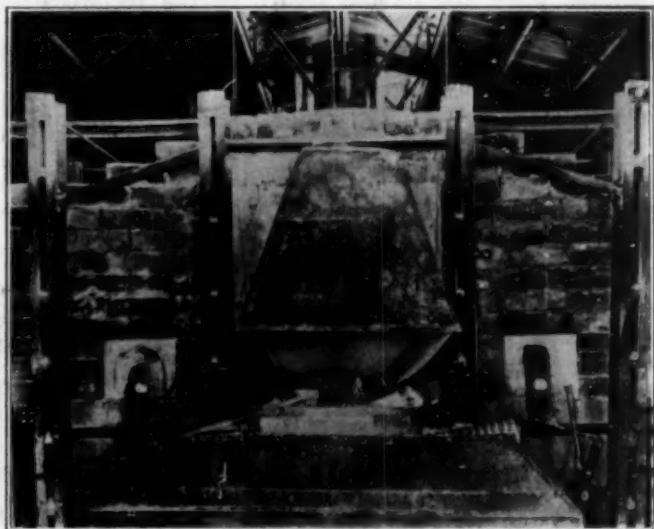
is a pot furnace with a capacity of a single pot holding 500 lb. of batch. The glass pots used in the glass factory are purchased from outside the plant except in special cases of experimental development.

The manufacture of the complicated shapes used in making scientific apparatus requires blowers of more than ordinary skill. In training these blowers to meet the war emergency, the glass-blowing art of the United States has been brought level with that of Europe. If the art is allowed to prosper here, we need never again be dependent on others for articles of this type.

DRAWING TUBE AND ROD AUTOMATICALLY

The tube machine department houses the equipment for drawing tube and rod automatically. The glass is melted in a continuous tank furnace of 20 tons daily capacity. This furnace is heated by producer gas supplied from the adjacent producer house under pressure and is of the regenerative type. It is provided with an indicating pyrometer. Placed immediately behind the refining end of this tank are four tube-drawing machines, fed with glass through separately heated feeding furnaces. These machines, which are a new and successful application of automatic machine principles to the glass industry, are manufactured by the Libbey Glass Manufacturing Co., of Toledo, Ohio. By means of them tubes or rods can be automatically drawn covering a wide range of diameters. A detailed description of the operation is given toward the close of this article.

The tube or rod is cut to lengths of 5 or 6 ft. in the tube machine and delivered by this machine to a storage rack. From this rack it is taken to the grading and sorting tables. Here the diameters of the rods are carefully measured and they are sorted into grades varying by $\frac{1}{16}$ in. These different grades are then placed in wooden boxes and taken either to the warehouse for shipment or stock, or to the cold metal department for manufacture into towel bars or similar articles. The tubes are carefully gaged inside and outside and are sorted into groups according to the inside diameter and the wall thickness. The drawing machines make about five different wall thicknesses for each different inside diameter of tube drawn. After sorting, the tubes are disposed of in the same manner as the rods, except that in the cold metal department they form the basis of the manufacture of a great many objects such as vials,



CHARGING END OF TANK FURNACE

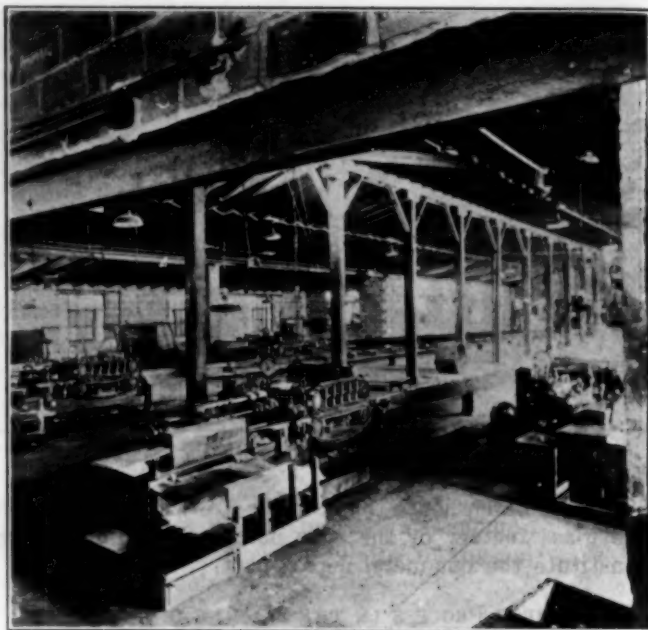
test-tubes, gage glasses, containers, oil cups and parts of scientific instruments.

CUTTING AND SORTING GLASS TUBES

The cold metal plant consists of the cutting, sorting, lamp, machine, graduating, etching and finishing departments. All the products of the hot metal plant which are to be finished in this works are first brought to the cutting building. Here tubes and rods are cut to the required lengths and the remains of the gather and other superfluous glass are trimmed from the blown shapes. The trimming of shapes is done by hand. Rods and tubes are cut by circular glass saws, some hand fed and some machine fed.

From the cutting building the glass is taken to the sorting department on the ground floor of the building in which the lamp and graduating departments are located and immediately adjacent to the building housing the automatic vial machines. Here the stock for the lamp department is separated from that for the machine department and the sorted stock is stored for delivery to these departments as required.

An interesting machine has been developed for sorting the tubing for the machine department into the five different weights in which each diameter is made. A large number of pieces of tubing, each of the required diameter and cut to the required length, say 5 or 6 in., is placed in the hopper at the top of this machine. From this hopper the pieces are fed one by one onto a reciprocating and oscillating step bar having six steps and made of two similar steel strips spaced about 3 in. apart. The upper step has one groove for receiving the tubes and the five other steps each have two grooves. The reciprocations and oscillations are both accomplished in the same plane, at right angles to the axis of the piece fed from the hopper and having an axis inclined to the vertical about 45 deg. The amplitude of the oscillations from this axis is at a maximum about 3 in. either side, so that each groove describes a complete and rather flat ellipse for each cycle. At each upward stroke the reciprocating bar picks up in the groove on its top step a piece of tubing. As the bar starts on the downward trip, a pivoted and counterweighted piece, situated between the two parts of the bar, takes the piece of tubing off the top step into a groove cut in its outer end. Should the piece be of the lightest grade, it is not sufficiently heavy to tip this pivoted piece and on the return of the reciprocating



DELIVERY ENDS OF AUTOMATIC DRAWING MACHINES SHOWING RACKS FOR RECEIVING LENGTHS OF TUBE

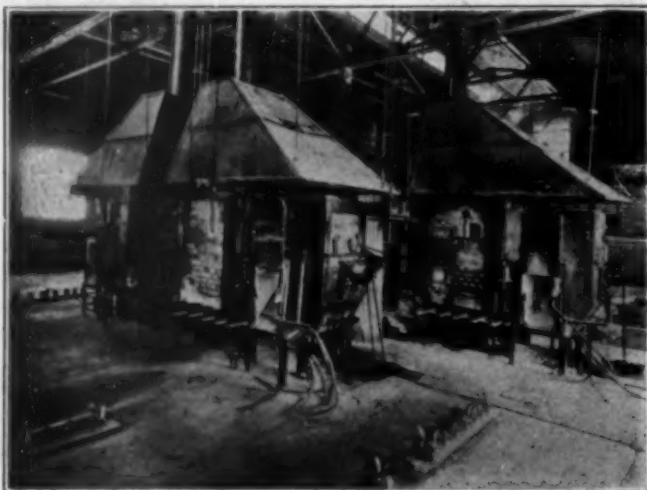
bar it is picked up by the outer groove on the second step. All pieces heavier than the lightest grade tip the pivoted piece sufficiently to cause the tube to be picked up by the inner groove of the second step. Pieces in the outer groove are tripped off into a tray at the next oscillation of the bar, while those on the inner groove are picked up by the second pivoted and counterweighted piece. By a repetition of this series of movements the five different weights of tube are separated one from the other.

HOW THE SCIENTIFIC WARE IS FINISHED

All the stock which is to be worked up by hand is taken from the sorting area to the lamp department, on the second floor of the same building. Here the different articles are made by the usual combination of gas burners and hand tools. It is here that the complicated pieces of scientific ware are formed and it is worthy of note that this art has been developed by American workmen on a commercial scale, proving that the United States is able to compete in highly skilled hand trades, at least in her own markets, with the products of low-paid European labor.

A large portion of the product, on leaving the lamp department, is completed and is taken directly to the packing rooms. Other pieces which are for measuring purposes require graduation. The pieces on entering the graduating room are first calibrated and tested by men especially trained for the work, which requires delicate skill and extreme accuracy. These men place gage marks on the articles delimiting the portion of which the volumetric capacity has been determined. The pieces are then thoroughly covered with wax. They are then placed in the graduating machines and the required number of spaces is marked off between the determined points by making scratches through the wax to the glass.

The graduating machines are of both the hand-operated and motor-driven types and are similar to the dividing machines usually seen. However, in order to obtain the extreme accuracy required for scientific instruments, it has been necessary to build these machines



FEEDING FURNACES AND DRAWING MACHINE IDLERS

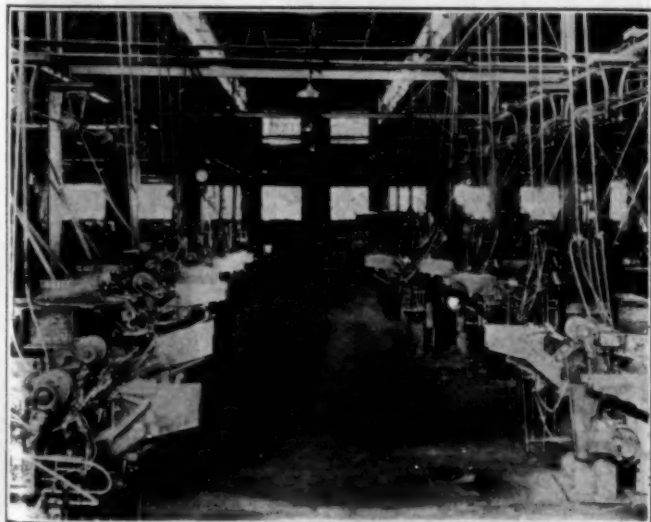
for the special service of this plant, as the ordinary machine such as is used in graduating thermometers is not of sufficient accuracy. At the present time, new machines are in course of construction, by means of which it is expected that the Bureau of Standards ware can be machine graduated. This ware is now graduated in the laboratory by hand by the most skillful workers employed in the plant.

ETCHING

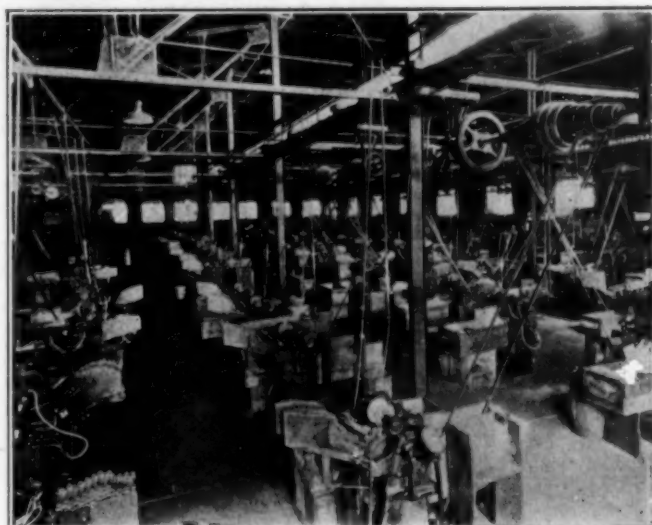
For placing the figures, letters and other symbols on the ware to be etched, there are several machines adapted from the principle of the pantograph and very much like the machines used in engraving. The operator traces an enlarged outline of the desired character, and this outline is transmitted through the motion of the machine, in reduced size, to the desired place on the work. After the desired markings are made through the wax covering, the pieces are attached to trays by means of melted wax. These trays are then dipped into a bath of hydrofluoric acid, which etches the glass through the scratches. On removal from the acid bath, the glassware is placed in a machine similar to the ordinary dishwashing machine, where it is exposed to a live steam spray. The wax is melted off, and together with any acid which was on the piece, is washed down a drain to the floor below with the condensed steam. Here the wax is separated from the acid and water, is purified and is then returned to the graduating department to be used again. The etched pieces are dried. The markings are then filled with a substance to make them stand out clearly. In another part of this room such finishing operations as the grinding of stoppers, cock-valves, etc., placing electrodes, finishing and polishing towel bars are performed.

AUTOMATIC MANUFACTURE OF VIALS AND TEST-TUBES

The tubing which is to be worked up into quantity products such as test-tubes and vials is brought from the sorting room into the adjacent building which houses the automatic machines. These machines are a development of this plant and represent a distinct departure in the glass-working industry. The principle of operation is the same, no matter what the product turned out, and different products are obtained by different applications of heat, compressed air and mechanically operated forming tools.



AUTOMATIC MACHINES FOR MAKING CORKAGE ON VIALS

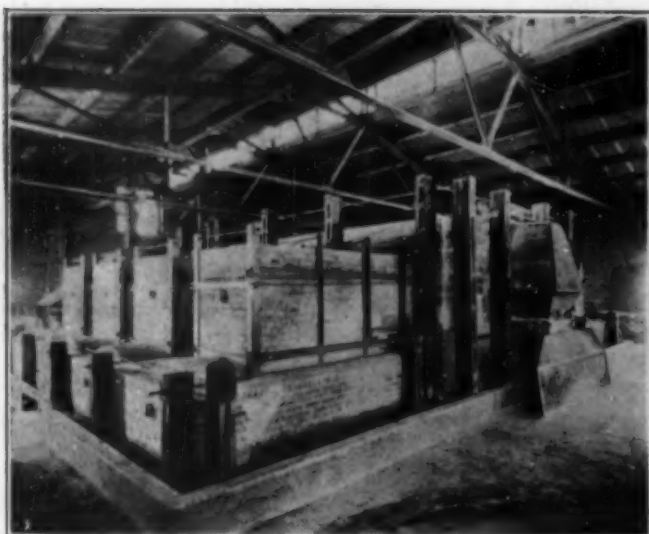


AUTOMATIC MACHINES FOR MAKING BUTTS ON VIALS

The machine used for making test-tubes is a good example of the methods followed. Here the stock is fed from a hopper, one piece at a time, down an incline to a point where it is taken up between two sets of revolving rollers. These rollers are mounted in pairs on shafts parallel to each other and to the axis of the piece of tubing. The tubing lies in the groove formed between the two sets of rollers. The rotation of the rollers causes it to revolve, and at the same time one end is subjected to the heat from several gas burners. When it is sufficiently heated, the gas burners automatically move out of the way and a forming tool or die is brought into play which forms the flange of the heated end of the tube. This flange being formed, the piece is then ejected from the first set of rollers and moved along a set of conveying rolls to another set of rollers similar to the first. Here the flange is formed on the other end of the tube. The piece then moves to a third set of rollers. Here the heat is applied to the middle portion in such a manner that when the tube is drawn slightly apart by a pressure exerted on the two flanges, it is separated into two pieces, each piece having a closed end. While these closed ends are sufficiently hot to be worked, the gas burners are withdrawn and a forming tool is brought into contact with each of them. At the same time compressed air is introduced into the outer ends of the tubes and the hot glass is caused to form an even spherical butt for the tube, filling out the cup in the forming tool, the glass being evenly distributed throughout the butt. This completes the tube, and it is released and conveyed into a hopper at the end of the machine for finished pieces. The cycle of operations is repeated for every tube made by the machine, and as a result the product is absolutely uniform. Also, due to the fact that in forming the butt the air pressure is under absolute control and the glass is caused to spread evenly and is more homogeneous than in the hand-made product, a test-tube is made of much greater strength than by the older method. At the same time it looks better and can be sold at as low a price.

THE PACKING, SHIPPING AND WAREHOUSE DEPARTMENTS

After the glass has been through the final manufacturing process it is taken to the packing rooms to be placed in the appropriate containers. These containers are made on the ground from semi-finished stock pur-



TANK FURNACE FOR AUTOMATIC DRAWING MACHINE

chased outside, and are of both paper and wood. The department is commodious and well arranged, but the methods used are the usual methods of hand packing and present no feature worthy of special notice.

From the packing rooms the filled containers are either shipped by truck or rail, or taken to the warehouses and placed in stock. These warehouses are conveniently placed on either side of the main track leading out of the plant. The stock is handled into and out of the packing rooms and warehouses on storage battery trucks or on hand trucks as may be convenient.

There is a very complete machine shop in the plant, used for making repairs to the existing equipment and for the manufacture of the automatic machinery which was described above. This department is located in a separate building, placed directly adjacent to the machine department, where most of the work for the shop originates.

POWER, HEAT AND PRODUCER GAS

Electric power is purchased from the Vineland Electric Co., about 15,000 kw-hr. being the monthly load for all purposes. High-pressure steam for the compressors, the producer and for process use is supplied from a 125-hp. water tube boiler. Low-pressure steam for heating purposes is supplied from four small heating boilers, placed in a separate building located centrally to the buildings where this heat is needed. The producer, supplying gas for the tube-machine tank furnace and for process uses in the various departments, is a standard Chapman producer. The amount of gas produced is about 1,000,000 cu.ft. per month.

LABORATORY

The laboratory consists of two divisions, physical and chemical. The physical laboratory tests the products after annealing for strain and for strength and makes other similar tests as needed. For the present the Bureau of Standards ware is calibrated and marked here, but this work will be transferred to the graduating room when the graduating machines mentioned above are in operation. The chemical laboratory does experimental work in the development of new kinds of glass, makes tests for process control, and tests the materials used in the plant. These tests do not include the specification tests on raw materials, which are peri-

odically made in an outside laboratory by a consulting chemist.

MACHINERY FOR AUTOMATICALLY DRAWING TUBING

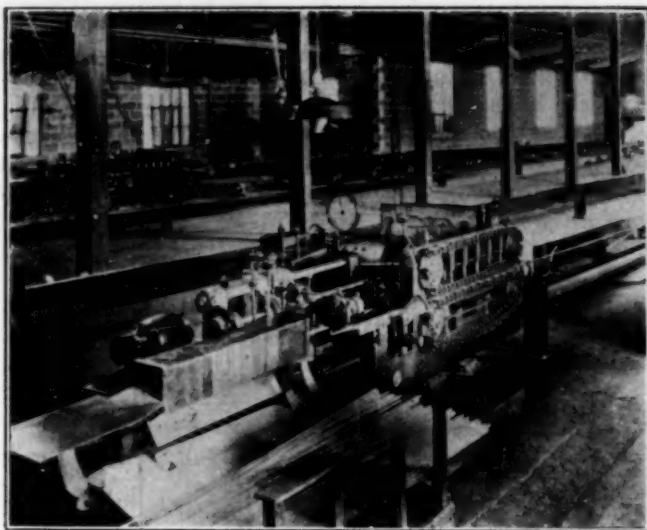
The machine used in the automatic manufacture of tubes and rods is not a new development peculiar to this plant; but as its use is by no means general, a description of it should prove of interest. The molten glass is fed onto a slowly rotating arbor which is situated in a heating furnace. Four of these heating furnaces are placed at the refining end of a tank furnace opposite the feeder openings. The feeder opening is connected to the heater furnace by a separately heated trough, so located that the glass flowing through the trough flows onto the arbor and forms a complete film over it. The arbor is mounted with its delivery end somewhat lower than the other end and in the start of the process a knob or lump forms on this end as the glass flows over the arbor. The operators attach a bar to this knob and walk rapidly away from the arbor. At the same time a current of compressed air is introduced within the glass from a hole in the delivery end of the arbor. In this manner the propagation of the tube is commenced.

As soon as the tube has been drawn out by hand to a suitable diameter, the operators place it in the machine and the drawing is continued as long as the supply of liquid glass continues to flow over the arbor.

Immediately following the rotating arbor and on a line which is a continuation of the horizontal projection of the axis of the arbor is a series of grooved idler wheels. These wheels are placed near the floor of the building and at a somewhat lower level than the delivery end of the arbor. In the machines in use at the Kimble plant the row of idlers is about 120 ft. long. The tube, which is placed in the grooves of these idlers and held there by means of asbestos guides, passes over them into the pulling machine. This machine supplies the motive power for the drawing after the operators place the tube in it. The pulling element consists of two endless chain belts, one above the other, in line with the tube as it leaves the idlers. These belts are made of links from 3 to 4 in. in length and carrying at the outside surface of the chain over each joint a pivoted, asbestos-covered plate which serves to grip the tube. The lower chain runs over a rigid guide, and the lower strand of the upper chain runs through an ad-



HEATING FURNACES, ARBOR AND INTAKE OF DRAWING MACHINE, SHOWING TUBE ON IDLERS



PULLING MACHINE, CUT-OFF AND STORAGE RACK

justable guide which holds the chain on the tube by spring pressure and can be moved up or down to accommodate different sizes of tubing. The pair of sprockets driving the upper chain are also provided with a vertical adjustment. This pulling machine is driven by a motor.

HOW THE AUTOMATICALLY DRAWN TUBE IS CUT IN USEFUL LENGTHS

On the other side of the pulling machine from the train of idlers is located the cut-off. This consists of a circular glass saw with its axis of rotation parallel to the travel of the tube, arranged to be moved back and forth along the path of the tube and also capable of being moved against and away from the tube. The machine can be set to cut the tube in various lengths as desired. When a sufficient length of the tubing projects from the pulling machine the saw is brought forward horizontally so that its swiftly rotating edge is against the tube. At the same time it is caused to travel with the tube and at the same speed. When a notch is completed the saw is withdrawn horizontally and makes a quick return to its first position in time to pick up the next length of tube as it issues from the pulling machine.

The piece of tubing which was notched by the saw is broken off by the movement of a slotted disk forming one end of a wheel made up of a series of long sheet metal vanes. It falls between two of the vanes and by its weight causes the wheel to revolve. As the vane inclines the piece of tubing rolls off into the storage rack and the wheel comes into position to receive the next piece broken off. All the motions described above may be set to suit the particular work to be done and are then accomplished automatically until the setting of the machine is changed. To make rod instead of tube the only difference is that a solid arbor is used at the head of the machine, no current of air being needed.

CONCLUSION

In conclusion, the writer believes that the plant described above is noteworthy for three reasons: First, for the development of the manufacture of glass by automatic machinery; second, for the manufacture of precision scientific glassware in the United States on a commercial scale, and last, for the training of a force of skilled glass workers capable of blowing and working up the most complicated articles.

Recent Developments in the Sulphur Industry

In connection with the recent announcement by the Freeport Sulphur Co. that it had reached an agreement with the Texas Co. by which the Freeport obtains the sulphur lease at Hoskins Mound, the sulphur deposit owned by the Texas Co., attention is called to the growth of the industry in this country by an article in *Financial America* of March 25, 1922. It is believed in trade circles that the arrangement just concluded will have a stabilizing influence over the industry, particularly as it eliminates the possibility of a fourth sulphur company in this country. The Texas Co., it is stated, has been endeavoring for a couple of years to enter upon such an arrangement, and other companies besides the Freeport have also made proposals.

The total sulphur reserves of the Texas Gulf Sulphur Corporation are estimated at over 15,000,000 tons, notwithstanding that in excess of 2,000,000 tons of commercial sulphur already has been taken out of its mines. The Union companies' sulphur reserves are estimated as in the neighborhood of 4,000,000 tons, those of the Texas Co. in the Hoskins Mound at between 5,000,000 and 6,000,000 tons and those of the Freeport Sulphur Co. at around 2,000,000 tons. The Freeport Sulphur Co. has not been operating its mines since April 1, 1921. The amount of sulphur that it had mined up to that time was slightly in excess of 2,000,000 tons, of which there was then above ground 343,609 tons.

Engineers who have been employed to ascertain the facts relative to the extent of the deposits in the Hoskins Mound say that it will probably require 2 or more years completely to develop and equip it and until the first two or three hundred thousand tons have been actually placed on the surface it will be impossible to predict whether the quality of the sulphur will be such as to meet the trade requirements.

Would Increase Chilean Iodine Production

Recently objections have been voiced in Chile against the monopoly which has been exercised for 34 years in the control of the iodine trade, according to the statement of Commercial Attaché C. G. McQueen, of Santiago. Claims are made that the possibility of modern application of iodine to industrial processes would warrant a thorough extraction of the material and the lowering of prices to a commercial scale. The present arrangement requires that all iodine contained in the ore whose extraction is not permitted by the quota assigned the plant must be thrown away and lost entirely. Statements are made that in place of the quantity of iodine now extracted and exported (something over 500 tons annually) from 10,000 to 14,000 tons could be produced if all the iodine contents of the treated ore were recovered.

The advocates of free elaboration and sale of iodine base their arguments on the three following grounds: The greater revenue derived by the government from a greatly increased exportation, even at a lower rate of duty; the possibility of using a free production of iodine and its sale at a fair profit as a means of adding to the revenues of individual producers and lowering the cost of the nitrate of soda to a point which will aid in recovering the ground recently lost to artificial nitrogenous fertilizers; and the liberation of iodine from exclusive use in pharmacy on the presumption that a lower price would encourage its use for other purposes not practiced because of prohibitive cost.

The Piette Coke Oven

BY HECTOR PRUD'HOMME

Vice-President and General Manager,
Belgian American Coke Ovens Corporation

THE Piette type of coke oven was built experimentally for the first time in the United States by the Franco-Belgian Coke Oven Corporation of Brussels, Belgium, at the Carondelet coke-oven station of the Laclede Gas Light Co., St. Louis, Mo. This construction of eight ovens was made for the purpose of a demonstration preliminary to the organization by the Franco-Belgian Coke Oven Corporation of the Belgian American Coke Ovens Corporation. Very minute tests have been conducted on these ovens by the Laclede Gas Light Co. during 30 consecutive days and the ovens have been in regular operation for over 14 months. The Franco-Belgian Coke Oven Corporation has more than 1,500 modern ovens in commercial operation in several countries in Europe. However, the construction in St. Louis, which was made exclusively at the expense of the Franco-Belgian Coke Oven Corporation, was experimental and, therefore, limited to eight ovens.

The efficiency of the new ovens has drawn the attention of experts in metallurgy and gas works of many states of the country. They are regarded by their designer as the coronation of many years of effort toward improving processes for carbonizing coal and the recovery of byproducts. Beyond any doubt these ovens will materially assist toward a more economical utilization of the natural resources of the country.

GENERAL CHARACTER OF THE OVEN

The Piette oven is of the horizontal type, with vertical flues, transverse regenerators and reversing arrangement. The regenerator chambers run the whole

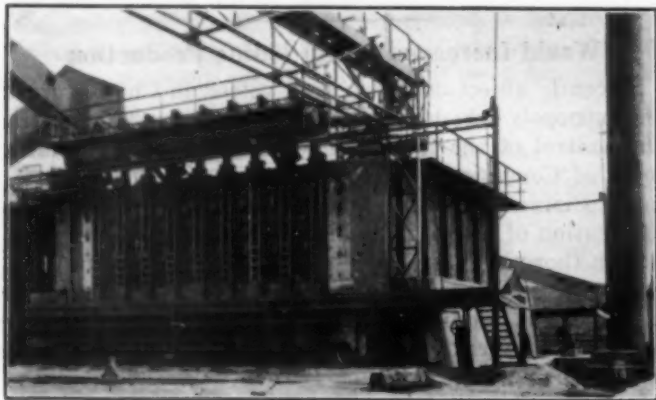


FIG. 1. GENERAL VIEW OF OVENS

length of the battery at right angles to the heating walls and oven chambers. This intercrossing of the walls is designed to give maximum of stability to the whole structure. Arrangements are provided for expansion when the ovens are heated, so that no fractures will occur to interfere with the proper working of the ovens.

Although arranged in longitudinal chambers, the regenerators are actually of the transverse type, and the products of combustion cross through the checkerwork in a direction parallel to the center line of the oven and travel longitudinally only after arriving in the free space of the secondary chamber. The total resistance is thus lowered to 5 or 6 mm. of water-gage, instead of the 30 mm. usual in longitudinal regen-

erators. In this way the pressures in the oven chambers and heating flues are more nearly equalized, and a maximum of gas-tightness and a maximum recovery of by-products is assured.

While not essential, the use of a fan for the air supply will tend more nearly to equalize the pressures between the oven chamber and the heating wall, and

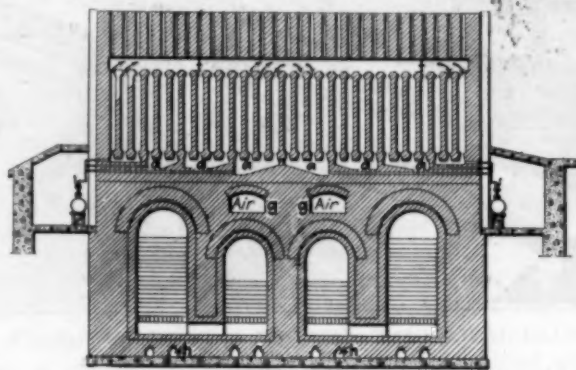


FIG. 2. SECTION THROUGH HEATING FLUES

prevent the passage of gases in either direction as the ovens become older.

REGULATION OF GAS AND AIR TO HEATING FLUES

The center-line of the battery divides the heating wall into two symmetrical parts, reversals being made from one half to the other. The space between the sole flues of each half is divided into four chambers *a* (Fig. 2), each fed by an individual gas supply pipe provided with its regulating cock and distributing the gas to four vertical flues. Independent of these cocks, there is also a control cock common to each half-wall. The air for each half is regulated by a damper *r* (Fig. 3), at the inlet to the sole flue *s* (Fig. 3) of the oven adjoining. The area of the air-nozzle for each burner is determined with great care.

This oven may also be constructed, if desired, by arranging the reversal from one group of two or three flues to the next group of two or three, by slightly modifying the method of coupling the vertical flues with the sole flues, and using suitable reversing cocks.

The air for combustion is drawn through flues *g* (Figs. 2 and 3) to absorb the heat radiated downward from the sole flue, as well as through air ducts *h*, to take up the heat radiated downward from the regenerators. Thus preheated, the air arrives at the reversing valve and is there directed alternately into one or other of the secondary regenerators.

The several means of control, to which there is easy

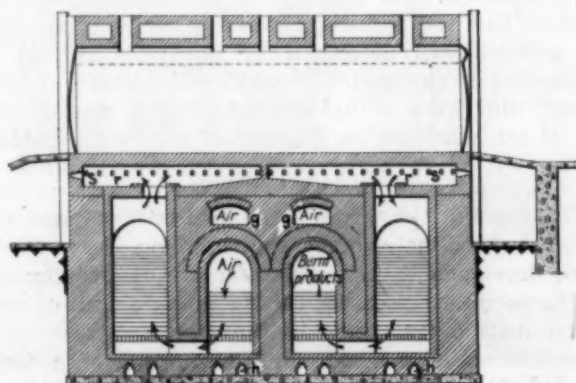


FIG. 3. SECTION THROUGH OVEN CHAMBER

access, enable great regularity of heating to be obtained, at a high, even temperature. The reversal of the draft and the operating of the burner valves are carried out by the working of a single lever.

To make the operation of the oven easy and certain, sight-holes for the examination of every part are provided, one for each vertical heating flue on top of the ovens, one in each half of the sole flue *s*; one in each horizontal flue *t* (Fig. 2) in the heating wall; one in each regenerator chamber. Those who are superintending and controlling the ovens have thus every facility for even heating of the battery at any speed.

OPERATING TEST OF EXPERIMENTAL BATTERY

The dimensions of the eight ovens installed at St. Louis are as follows:

Height of oven chamber.....	9 ft. 10½ in.
Length between doors.....	37 ft.
Average width.....	19½ in.

The ovens were maintained in regular operating condition for the production of coke of good quality and for maximum yield of available gas of high calorific value. The 30-day test was begun after the ovens had been operated for 3 months. The figures in Table I show in more detail the results obtained.

The mixture of coal charged in these ovens during the 30 days of tests was as follows: 65 per cent of high volatile coal (Elkhorn from the Consolidation Coal Co.) and 35 per cent of low volatile coal (Pocahontas from the Cleveland-Western Coal Co. of West Virginia). The average analysis of this mixture was:

	Per Cent
Moisture	4.43
Volatile	29.06
Fixed carbon	61.37
Ash	5.14

100.00

The yield of coke and the researches as to its nature were made by weighing daily the load of one oven, which was then screened and the samples submitted to laboratory tests. The results are given in Table I. The screening was done on an inclined 2½-in. roller grizzly screen.

These figures show that the yield in available B.t.u. would be, after deducting the B.t.u. needed for heating the ovens, 60.9 per cent of the total quantity of B.t.u. produced. This already very satisfactory proportion does not, however, represent the real power of this system of ovens.

A small number of ovens can, of course, not give the same yields as a bigger battery, of say fifty or sixty or more ovens of the same type. In the case of a big battery the gas used for the heating of an end-wall, which was found to be more than half the amount used on one oven wall for intermediate flues, is distributed over a larger number of ovens and as a matter of course over a larger quantity of the coal distilled. If the heat used in one end-wall is distributed over a battery of fifty to sixty ovens, the average number in a modern battery, the reduction in B.t.u. consumed in comparison with a battery of eight ovens is about 6 per cent. Taking this into account, the calorific balance sheet of the Piette ovens working under the conditions described above at St. Louis is as follows:

	Per Cent
B.t.u. produced, 3,301.7 per lb. of coal.....	100
B.t.u. in the surplus gas, 2,088.4.....	63.25
B.t.u. consumed in the heating gas, 1,213.3.....	36.75

TABLE I—RESULTS OF TESTS

A. Ovens and coal:	
Number of ovens charged and pushed.....	282
Average coking time.....	20 hr. 18 min.
Average load per oven.....	26,770 lb.
Total quantity of coal charged in 30 days.....	7,549,400 lb.
Average quantity of coal charged in 24 hr. per oven.....	31,455 lb.
Average temperature of the smoke at the outlet of the heat regenerators corresponding to 8 per cent oxygen or an excess of 25 per cent of air.....	624 deg. F.
B. Coke:	
Total yield of dry coke calculated on coal as charged, per cent.....	69.19
Proportion of foundry coke in total coke.....	38.15
Proportion of other grades of coke.....	61.85
Average analysis of the total coke obtained, per cent:	
Moisture.....	1.94
Ash.....	6.77
Fixed carbon.....	90.33
Volatile matter.....	0.96
Specific gravity:	
Apparent.....	0.973
Real.....	1.906
Shatter test.....	55.57
Porosity:	
Coke substance by volume.....	51.03
Air spaces by volume.....	48.97
Total quantity of coke produced in 24 hours in one oven, lb.....	21,764
C. Heating gas:	
Volume of gas burnt during the 30 days in cu. ft. at 30 in. pressure and 60 deg. F.....	20,332,000
Volume of gas burnt per lb. of coal charged.....	2,693
Heating value of this gas (B.t.u. per cu. ft.).....	479.3
Consumption in B.t.u. per lb. of coal charged.....	1,290.7
D. Gas produced and B.t.u. available:	
Total volume of gas produced during the 30 days at 30 in. and 60 deg. F., cu. ft.....	44,159,000
Volume of gas produced per lb. of coal charged in cu. ft.....	5,849
Average calorific value of this gas (B.t.u. per cu. ft.).....	564.5
Total quantity of B.t.u. available per lb. of coal charged (non-debenzolated gas).....	3,301.7
B.t.u. (surplus) available per lb. of coal treated.....	2,011.0
Average analysis of the gas produced:	
Per Cent	
CO ₂	1.7
C ₂ H ₄	3.4
O ₂	0.4
H ₂	51.8
Per Cent	
CO.....	6.1
CH ₄	29.8
N ₂	6.8
Average specific gravity at 30 in. mercury and 60 deg. F. 0.39. Yields of byproducts per ton (2,000 lb.) of coal carbonized:	
Ammonia (NH ₃), lb.....	5.63
Tar, dry, gal.....	7.01
Benzene (product distilling below 200 deg. C.), gal.....	3.42

This consumption is the smallest yet realized in the United States considering the conditions imposed by the tests.

ADVANTAGES CLAIMED FOR THE PIETTE OVEN

The most important characteristics of the Piette oven are:

1. The carbonization chamber and the whole structure are perfectly tight, which has been shown during the St. Louis tests. This, together with a perfect regulation of the heating and the excellent heat regeneration qualities, has permitted the extraction from the coal of the maximum of byproducts.

2. Short-circuits in wall flues have been done away with through the reunion, in two continuous series, of the upward-flame and downward-flame flues. This arrangement acts favorably in the exchanges of heat with the consequence that the work of the regenerators is facilitated.

3. The distribution of the gas in each oven wall by several compartments fed by individual tuyeres, each supplying the gas to three or four flues, permits the regulation of the quantity of gas admitted at every point of the oven in such a manner that it takes into account the effects of the taper and the cooling from outside.

4. The use of fixed regulating sections for the entrance of the air under the soles and the outlet of the burnt gases through the top of the vertical flues, which sections are calculated and confirmed by practice, makes the use of sliding bricks unnecessary. The placing of such sliding bricks is always very difficult for the heater who has charge of them, and it has been found many times that these small bricks remain stuck after some time, which fact prevents a first-class regulation of the

batteries where such device is employed. The unremovable regulation sections of the Piette ovens are superior, because they need no adjustment of any kind and are not exposed to the consequences of the whim or indifference of the heaters. More uniform heating of the oven walls is obtained, as was shown under every kind of running conditions at the new battery at the Laclede Gas Light plant.

5. The fact that the longitudinal regenerators work transversely, and thus establish an automatic regulation of the temperature of the combustion air, assists materially in the equalization of the heating of the several ovens of the battery, an advantage which does not exist in the ovens having individual transverse regenerators. The uniformity of the temperature of all the ovens of the battery which was noted daily at the St. Louis plant was a feature of the tests.

6. The two transversal-conjugated-regeneration galleries on each side of the center line of the battery allow (through a convenient regulation of the sections of the communicating openings existing between the primary gallery and the secondary gallery) for compensating the effect of the drop of pressure in the outlet gallery for the combustion products and for establishing correspondingly a uniform working of the depression for all the ovens. These sections are so calculated and the quantity of checkerwork placed in the secondary gallery is such that they are perfectly sized for the products going out and in the following period for the air coming in through them.

7. The aerating galleries *g* between the soles and the secondary regenerators as well as the galleries *h* under the heat regenerators assure a convenient cooling of the combustion products and a saving of radiating heat through a reduction of this radiation. These advantages were clearly shown during the tests referred to in this article, the air being heated to 200-280 deg. F. before entering the regenerators proper.

8. The stability of the ovens is remarkable. The regenerators are longitudinal to the center line of the battery and therefore perpendicular to the center line of the oven-walls and the arches of the ovens. This intersection of the walls and the ovens makes for a maximum solidity of the mass of the battery. Then the expansion of the linings and of the arches of the regenerators, as well as of the flues connecting the primary regeneration galleries with the sub-sole flues, is rendered completely independent of the general sustaining mass of the battery. The result thereof is that the refractory material which constitutes the sole-oven walls and the ovens are built on an absolutely rigid monolithic block which cannot be deformed. Such a disposition is remarkably advantageous with the silica bricks so extensively used in the United States which expand so much. The system in which the oven-walls proper of the oven are placed on regenerator walls, of which they are a part, can evidently not realize a similar tightness. The unequal temperatures which are found from the foot of the regenerator walls to the top of the oven-walls justify unequal expansions from level to level which cannot but cause cracks.

9. The ovens are easily operated and watched. As explained above, sight-holes are placed all along the passages of the flames and the gases, which are thus made accessible everywhere. The sight-holes placed at the end of the primary regenerators permit an inspection of the top of the checkerwork for the whole length

of the battery. The progress of the heating is easily followed by heat coloration and general aspect of the ensemble. This inspection shows whether any oven-wall is being insufficiently heated, due, for instance, to an accidental obstruction of a cock or of a gaspipe.

To these advantages let us add the very special care taken by the builder of this type of oven to avoid anything that may complicate the construction or the operation. The whole oven gives an impression of solidity and simplicity.

The Franco-Belgian Coke Oven Corporation builds other types of ovens also—ovens without heat regeneration, ovens heated from the top of the oven-walls adapted to special kinds of coals, and finally ovens heated either by producer gas or blast-furnace gas. In this article, however, only the type of oven installed at St. Louis is described.

Synopsis of Recent Chemical & Metallurgical Literature

The Strength of Mechanically Welded Pressure Containers.—In a paper published in *Mechanical Engineering*, April, 1922, and to be read at the spring meeting of the A. S. M. E., Prof. R. J. Roark gives the results of an investigation made for the Vilter Manufacturing Co., of Milwaukee, to determine the strength and uniformity of pressure containers with electrically welded head joints. The containers were made of lap-welded pipe and were provided with spherical flanged heads. Their dimensions

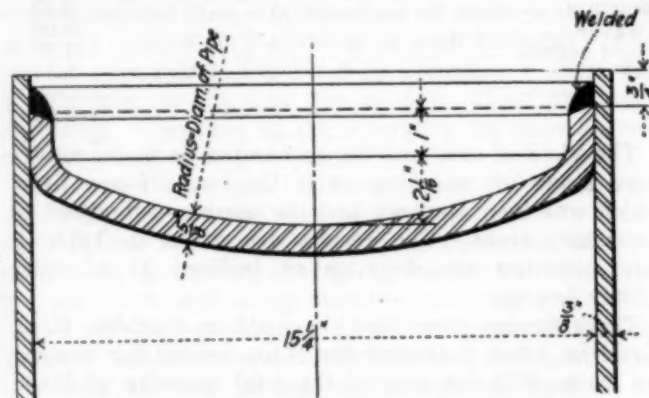


FIG. 1—SHAPE AND DIMENSIONS OF SPECIMEN CONTAINER

are given in Fig. 1. The average physical and chemical properties of the steel used were as follows: Yield point, 38,000; ultimate, 64,000; elongation, 27 per cent; carbon, 0.17 per cent; manganese, 0.44 per cent; phosphorus, 0.010 per cent; sulphur, 0.027 per cent.

It was proposed to determine the absolute strength of such containers by pressure tests on representative samples and to establish a comparison with vessels of like form and dimensions, but with gas welded and riveted heads. The tests were in three separate sets—namely, tests on containers, tests on specimens cut from containers and tests on special specimens of welded metal.

The tests on containers consisted in subjecting the specimen to an internal hydraulic pressure which was gradually increased until rupture resulted or such rapid leakage developed as to make further increase of pressure impracticable. The results of these tests are given in Table I. The values given for maximum shearing stress and maximum tensile stress in Table I do not represent the strength of the material in shear and tension, but simply the approximate shear and tensile stress produced in the welded joint

TABLE I—RESULTS OF PRESSURE TEST ON CONTAINERS

Specimen Number	Description of Specimen	Pressure in Lb. Per Sq. In. at			Method of Failure	Stresses on Head Joint at Maximum Pressure					Remarks
		First Observed Leakage	Driking of Heads	Maximum		Longitudinal shear lb. per linear inch of joint	Radial tension lb. per linear inch of joint	Bending moment inch-lb. per linear inch of joint	Max. resultant shearing stress lb. per sq. in.	Max. resultant tension stress lb. per sq. in.	
1	Standard commercial container with electrically welded heads, size 16 in. x 10 ft.	1,925 (1,820)		2,150 (2,040)	Longitudinal crack, started at nipple	7,770	870	1,780	9,800	15,000	
2	Standard type container with gas welded heads, size 16 in. x 10 ft.		2,150 (2,040)	2,200 (2,090)	Head forced off	7,960	900	1,820	10,500	16,000	Fracture on section B-B
3	Standard type container with riveted heads, size 16 in. x 10 ft.	1,200 (1,120)		2,100 (2,000)	Excessive leakage						
4	Container with gas welded heads and gas welded longitudinal butt joints, size 16 in. x 10 ft. (weld by Le Quelle)			1,600 (1,540)	Split along long. butt weld						
5	Container with gas welded heads and gas welded longitudinal butt joints, size 16 in. x 10 ft. (weld by Vilter)			1,300 (1,240)	Split along long. butt weld						
6	Container with electrically welded heads and electrically welded longitudinal butt joints, size 16 in. x 10 ft.			1,400 (1,340)	Split along long. butt weld						
	Reinforced container with electrically welded heads (3 concentric shells, concrete filled), size 10 in., 12 in., 14 in. x 3 ft. 2 in.		4,500 (4,800)	4,800 (4,680)	Head forced off	11,860			18,000		Fracture on sections B-B and C-C
8	Reinforced container with gas welded heads (3 concentric shells, concrete filled) size 10 in., 12 in., 14 in. x 3 ft. 2 in.	4,350 (4,230)	4,100 (3,980)	4,350 (4,230)	Excessive leakage at weld joints	10,720					
9	Special container with one electrically welded; one head riveted, size 16 in. x 2 ft.	1,750 (1,670)		2,500 (2,390)	Split along lap weld	9,100			11,600	17,600	

by a pressure which caused failure at some other point. In making tests on specimens cut from containers, tests were made for shear and tension. The form and part of containers from which the specimens were cut are shown in Fig. 2. Specimens of Type A were tested in tension, the ends being held in wedge grips. The breaking load, eccentricity at rupture and manner of failure were noted. From these data the computed ultimate stresses on the weld were determined. Specimens of Type B were tested in shear.

The tests on special specimens of welded metal were made with the purpose of determining the actual tensile and shearing strength of the welds.

In conclusion, the author states as follows:

1. *Weak Points in Containers.*—None of the welded containers of standard design failed primarily at the welded head joint. The nature of the fracture shows that the weak points in the containers were, first, the lap weld in

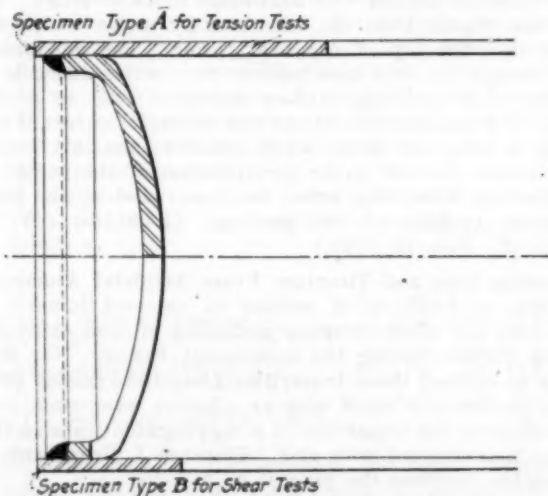


FIG. 2—SHAPE AND LOCATION OF SPECIMENS SUBJECTED TO SHEAR AND TENSILE TESTS

the pipe forming the shell, where failure occurred due to circumferential tension, and, second, the body of the shell at its junction with the head flange, where failure occurred due to the combination of longitudinal tension and bending. It appears that leakage is likely to occur first where couplings and nipples are welded in. This is due to the fact that the metal of the shell stretches and pulls away from the nipple, which does not have a corresponding strain induced in it by internal pressure.

2. *Strength of Electric Welds.* The average tensile strength of electrically welded joints was found to be 28,500 lb. per sq. in. From tests on specimens cut from containers, the average shearing strength of electrically welded joints was found to be 25,500 lb. per sq. in. The mean variation from the average tensile strength per linear inch of weld was found to be 2 per cent, and the maximum variation 4.5 per cent. The mean variation from the average shearing strength per linear inch of joint was found to be 5.2 per cent and the maximum variation 7.8 per cent. The results of eccentric tension tests on specimens cut from containers showed that no one of the specimens was markedly weaker than the average for the lot. It is believed that the uniformity of strength thus indicated is of special interest and importance.

3. *Relative Strength of Electrically Welded and Riveted Joints.* The tension tests on specimens of Type A indicated that the resistance to tension applied with a large eccentricity is greater for the riveted joint than for the welded joint. The shear test on specimens of Type B indicated that the resistance to shear per linear inch of joint is greater for the welded joint. Measurements to determine the elastic and permanent protusion of the container heads showed that for the two specimens so tested the welded container withstood a somewhat greater pressure without permanent distortion. In the case of the riveted containers, leakage occurred at the head joints under moderate pressures. In the case of the electrically welded containers there was no leakage at the head joint under any pressure.

4. *Efficiency of Electrically Welded Joints.* While it is customary to speak of the efficiency of a joint, whether welded or riveted, meaning the ratio of the strength of joint to strength of plates joined, the writer does not believe that this ratio is especially significant in the case of electrically welded joints or that any value can be given it that can be regarded as generally applicable.

It is apparent that while the strength of the plates joined is dependent solely on the physical properties of the base metal, the strength of the weld is in great measure dependent on the properties of the filling metal. Furthermore, the per cent excess thickness of the weld, which influences its strength, varies with the thickness of the plates. Accordingly the efficiency of a weld depends on the properties of the base metal, the properties of the filling metal and the thickness of the plates.

The writer believes that the correct method of computing the efficiency of an electrically welded joint is on the basis of a specified minimum strength of base metal, a specified minimum excess thickness of weld and an experimentally determined average strength (per sq. in.) of the metal of which the finished weld is composed.

Elektron.—Lieutenant-Colonel Grard published a note on "Light Alloys Used in Aeronautics" in *Revue de Metallurgie*, 1921, p. 567, from which the following notes on the German alloy elektron are extracted:

Elektron contains approximately 90 per cent Mg, 5 per cent Zn and 5 per cent Al. Sheets of a similar alloy of French make test as follows:

Elastic limit, lb. per sq. in.	27,000
Ultimate strength, lb. per sq. in.	36,000
Elongation, per cent.	22
Specific gravity, (33 per cent lighter than aluminum)	1.8

German alloys are advertised with the following properties:

	Alloy "GM"	Alloy "Z"	Alloy "AZM"
Electrical conductivity	22	17	12.5
Temperature coefficient	0.0038		
Thermal conductivity	0.38	0.38	
Specific heat	0.25	0.24	0.24
Thermal expansion	0.000027		
Melting point, deg. C.	650	635	530
Specific gravity	1.74	1.83	1.84

Lowering the temperature from 20 deg. C. to 0 deg. C. lowers the elastic limit, ultimate strength and elongation all about 4 per cent. At 100 deg. C. the elastic limit is reduced 12 per cent, the ultimate strength 5 per cent, and at the same time the ductility increases.

Elektron shavings are flammable, especially when moist. Masses of metal do not burn until melted. It is not attacked by alkalis except ammonia, but is corroded rapidly by acids, even weak organic acids. It reacts violently to salt solutions, chloride and sulphates of heavy metals. It is perfectly resistant to acid-free petroleum products. It may not be used where it is continually wet; atmospheric corrosion builds up a gray coating. Recommended protective coatings are varnish and condensation products like Bakelite.

Elektron must be separated from copper by sheets of aluminum or of fiber.

Elektron cannot be welded or soldered. Cast ingots can be forged or stamped at 225 deg. C.; and drawn or rolled from 400 to 300 deg. C. Extrusion is performed at 400 deg. C. Annealing is done at 400 deg. C.

Properties of Some Steels in the Hardening Range.—W. R. Chapin¹ has made some interesting tests on some oil- and water-hardening steels which harden to the center in $\frac{1}{2}$ -in. sections when quenched from about 1,500 deg. C. The steels were ordinary water-hardening carbon tool steels, of the following approximate compositions: C 1.10, Mn 0.3, Si 0.3; nickel-chromium steels with C 0.9, Mn 0.4, Si 0.16, Cr 0.8, Ni 1.5, and a "non-shrinking steel" with C 0.77, Mn 1.48, Si 0.41, Cr 0.06, V 0.19. He would quench these steels, and remove them from the bath when in the hardening range (400 to 500 deg. F., judging by tempering colors), caliper them and make hardness tests quickly before the steel had cooled very much. It was found that oil-hardening steels in and just above the hardening range were non-magnetic, soft to Brinell impressions² (180 to 190) but file hard. They were also shrunken, as compared to the original annealed condition, to the extent of a little more than $\frac{1}{2}$ of 1 per cent in linear dimension.

Magnetism returns slowly to the steels as the temperature drops; the Brinell hardness also increases greatly. Eventual hardness appears to be unaffected by the rate of cooling below the hardening range, and amounts to 650 \pm 25. However, there is less distortion and less ultimate change in volume and a better developed martensitic structure after a very slow cooling from the hardening range; hence the logic of removing from the bath at 300 deg. F. and burying in lime, or immersing it for perhaps 15 minutes in an oil bath at 250 deg. F. Shrinkage observed at the hardening range is more than recovered in subsequent cooling to room temperature, despite the concurrent contraction due to drop in temperature, which alone amounts to 0.25 per cent. Total increase in length due to the transformation is therefore about 0.55 per cent, corresponding to a volume increase of 1.65 per cent.

¹Transactions, American Society for Steel Treating, March, 1922, p. 507.

²Brinell impressions are rounded at the edges.

Oil-hardened steels tempered 15 minutes at 250 deg. F. remained at 683 Brinell and were file hard. Drawing 15 minutes at 400 deg. F. decomposes some martensite, the Brinell hardness remains practically unchanged, but it can be filed slightly. A second 15-minute draw at 400 deg. F. drops the Brinell hardness 25 points, and the sample files easily. If drawn at 800 deg. F., the steel shrinks 0.20 per cent in length from its hardened state.

Water-hardening steels $\frac{1}{2}$ in. square are magnetic in the hardening range, and are not shrunk in volume. If the thickness be reduced to 0.05 in., the same steel hardens readily in oil, and develops the same characteristics discussed at length in the foregoing paragraphs.

All these facts support the theoretical conclusion that the Ar range is depressed to at least 500 deg. F. by quenching; above that temperature, ductile, non-magnetic gamma iron exists. Below that temperature, magnetic alpha iron, of slightly less specific gravity is stable.

Dr. Jeffries pointed out that the volume change recorded in the interval between hardening range and room temperature was about that which would be computed from the change from the space lattices characteristic of gamma iron to that of alpha iron, less the thermal contraction, and disregarding entirely the contraction due to the formation of Fe₃C from molecular carbon and iron. He interpreted the results to mean, therefore, that the formation of martensite involves the allotropic change in the iron, but not the formation of any cementite.

Recent Chemical & Metallurgical Patents

American Patents

Complete specifications of any United States patent may be obtained by remitting 10c. to the Commissioner of Patents, Washington, D. C.

Nitric Acid Fume Recovery.—The invention describes an apparatus designed to recover the nitric acid fume loss from nitrating operations. The apparatus consists of three brick towers in series packed with acid-proof brick or rings. The fumes are drawn from the nitrators by a fan which discharges into the top of the first tower. The gas passes down through the first two towers, over which there is no circulation, the packing surface merely acting as a condenser. The uncondensed fumes rise through the last tower, meeting a spray of water which removes the last traces. The principle claimed is the precipitation of the fumes by the expansion when they enter the tower and by the large condensing surface of the packing. (1,406,353. W. de Sveshnikoff. Feb. 14, 1922.)

Removing Iron and Titanium From Artificial Aluminous Abrasives.—Addition of carbon to calcined bauxite or emery does not effect complete reduction of iron oxide and titanium dioxide during the subsequent fusion. Nor is it possible to extract these impurities from the crushed product. A preliminary roast with an alkaline compound, however, will leave the impurities in a segregated state so that they can be extracted with acid. Clarence J. Brockbank, of Philadelphia, outlines the process as follows:

To a bauxite (Al₂O₃, 54.8; combined water, 30.5; SiO₂, 4.5; Fe₂O₃, 6.2; TiO₂, 4.0) is added sodium or potassium carbonate in the approximate proportion of 50 lb. to each ton of ore, the resulting mixture being then roasted in a rotary calciner to a temperature of approximately 1,100 deg. C., which is sufficient to remove the combined water. During this roasting process, the alkali combines with the metallic oxides and the silica, forming easily fusible silicates. The ore from the calciner is next mixed with sufficient coke to effect reduction of silica and iron, due allowance being made for the effect of the carbon electrodes, and the mixture fused in an electric furnace. For the above-described bauxite, coke in the proportion of approximately 22 lb. to 400 lb.

of the calcined bauxite will be found sufficient for reduction purposes.

After fusion, the pig or ingot of fused material is broken down, crushed by rolls to powder and then treated with a solution of sulphuric acid in the following manner:

The crushed grains are placed in a lead-lined wooden tank or other suitable receptacle, and sufficient of a 10 per cent solution of sulphuric acid added to completely cover the mass. Heat is applied by means of a lead steam coil, and the treatment continued for approximately 6 hours, when the material is washed and graded to different sizes of grains. (1,402,714; assigned to the Abrasive Co., Philadelphia. Jan. 3, 1922.)

Cellulose Acetate Solution.—Among the solvents which have been suggested for cellulose acetate is ethylene chlorhydrin, $\text{CH}_2\text{ClCH}_2\text{OH}$. While the acetate is readily dissolved, the solution is so extremely slow drying that it has not been used commercially. By adding an alcohol and an aromatic hydrocarbon to the chlorhydrin, however, a solvent is formed which will dry rapidly. The mixture may consist of: ethylene chlorhydrin, 5 to 25 parts; ethyl alcohol, 15 to 45 parts; benzene, 60 to 25 parts. To the solvent mixture thus provided the cellulose acetate is then added with stirring, the proportion of the latter to the former depending on the character of the product desired. One part of acetate to ten of the solvent mixture will give a clear, limpid solution, which may be readily poured or applied with a brush and which, upon exposure to the air at normal temperatures, will dry promptly, leaving a transparent film that will remain flexible indefinitely. (1,406,224; Mark E. Putnam and William E. Kirst, of Midland, Mich., assignors to Dow Chemical Co. Feb. 14, 1922.)

Production of Ethyl Alcohol From Acetaldehyde.—In the known processes for the production of alcohol by passing acetaldehyde vapors over a catalyst the yields depend largely on the exclusion of oxygen and acetic acid. But when oxygen is completely excluded from the mixture of gases, the resulting alcohol will often contain ether, which is objectionable in certain uses. If a large excess of hydrogen is used in the process, certain impurities such as CH_4 , CO_2 and CO are formed, and of these the carbon monoxide is particularly injurious to the catalyst. According to a recent patent all of these objections are avoided by passing over the contact body a mixture of acetaldehyde, an excess of hydrogen and up to 0.3 per cent of oxygen and then carrying out the process by removing the heat of reaction, at least in part, and after separating the alcohol formed, returning the excess hydrogen to the operation. The temperature is kept between 90 and 170 deg. C., because below 90 deg. the formation of alcohol is slow, while above 170 deg. the decomposition of the acetaldehyde rapidly increases.

The yield under such improved conditions is compared with the results of the complete exclusion of oxygen, in the following table:

	Experiment No.				
	66-67	68	69	70	71
Percentage of oxygen in the gases used.....	0	0.06	0.06	0.1	0.1
Added water, per cent of the condensed products.....	0	0	2.6	0	2.6
Yield of alcohol, per cent of the aldehyde.....	88	92	93	94.8	95.2
Content of aldehyde in the condensed products (in per cent).....	2	0.15	0.6	0.08	0.07
Content of ether in the condensed products (in per cent).....	3.5	1.5	1.5	0.5	0.5

(1,408,794; Theodor Lichtenhahn, of Basel, Switzerland, assignor to Elektrizitätswerk Lonza, of Gampel and Basel, Switzerland. Jan. 17, 1922.)

Dehydrating Petroleum Emulsions.—A series of patents relating to the dehydration of petroleum oils by the use of an electric current were granted on Jan. 31, 1922, to Ford W. Harris, of Los Angeles, Cal., assignor, by mesne assignments, to the Petroleum Rectifying Co. of San Francisco. As is well known, many oil wells produce an emulsion of oil and water and in many cases the water is present in the form of infinitesimal globules. Many investigators have recognized that by subjecting this emulsion to an electric current there is an agglomeration of the water globules, with consequent removal of the water by settling.

In most of previous processes the oil which is being subjected to the action of the current is carried in open vessels in which the treating electrodes are suspended. It remained for this inventor to devise a number of novel ways in which the emulsions could be broken without the necessity of providing a plurality of electrodes.

According to patent 1,405,117 a single containing vessel is used and but a single electric field is employed. The body of the fluid is repeatedly circulated through this field and hence repeatedly subjected to its action. By this means the inventor claims to obtain a large capacity at a small initial expense.

In patent 1,405,118 there is described "an electrical dehydrator comprising a tank, a treater, electrodes, a means for impressing an electromotive force between the electrodes, means for circulating oil from a tank through the treater and back into the tank, a pipe for withdrawing clean oil from the top of said tank, a water outlet pipe for withdrawing water from the bottom of the tank and means for introducing the wet oil to be treated into the tank."

The next patent in the series (1,405,119) provides an apparatus in which the emulsion, while being subjected to the electric current, may be safely heated to temperatures considerably above the boiling point of the lighter constituents. Heating some of the very heavy oils, such as those from 9 to 16 deg. Bé., has been found to be of considerable assistance in the coalescence of the water globules. Patents 1,405,120 and 121 deal, respectively, with a system of water controls for electrical dehydrators, and a closed dehydrating tank in which a body of water is constantly retained at the bottom.

A dehydrating apparatus utilizing a very concentrated electric field of small area and through which the emulsion is passed at a high speed is described in patent 1,405,122. A pair of electrodes in axial alignment gives the field. A vertical pipe forms the outer electrode and an iron chain supported within it forms the inner electrode of a dehydrator described in patent 1,405,123. Another dehydrator comprising a tank in which are disposed concentric cylinders adapted to alternate electric polarity and open at their tops and bottoms forms the basis of the next patent. Patents 1,405,125-127 are modifications of dehydrators previously discussed.

The claim of patent 1,405,128, however, depends on a new principle in dehydration—namely, the magnetic displacement of the current-carrying path. In this invention the currents flowing through the emulsions are formed in a magnetic field which is so arranged that the current path is constantly being forced around, thereby coming into contact with fresh portions of the emulsions, so that the whole mass is rapidly dehydrated. According to another process (1,405,129), the emulsion is forced under pressure through a confined space from which air is excluded and in which static charges are caused to take place. The last patent of this series (1,405,130) describes a dehydration which comprises mixing a coarse emulsion with a fine emulsion and subjecting the mixture to the action of the electric current. Apparently the addition of water in the form of a loose emulsion will often very greatly increase the capacity of the apparatus.

Manufacture of Lead Arsenate.—In order to prevent or substantially inhibit the clustering of particles of lead arsenate and the consequent settling when suspended in water, Robert E. Wilson, of Cambridge, Mass., has suggested the addition of a relatively minute quantity of some organic material capable of serving as a protective colloid. He has shown, for instance, that the addition of ordinary glue in the proportion of 0.005 to 0.5 per cent of the weight of the lead arsenate will produce a product which when shaken up with water shows scarcely any tendency to settle in so far as leaving a clear layer at the top of the mixture is concerned. Without such addition even some of the best products leave a substantially clear layer over the settled particles at the rate of $\frac{1}{2}$ in. per minute. It is claimed that the insecticidal power of the product is unimpaired and that its increased covering power makes the improved product more effective and economical to use. (1,393,474; assigned to Pittsburgh Plate Glass Co. Oct. 11, 1921.)

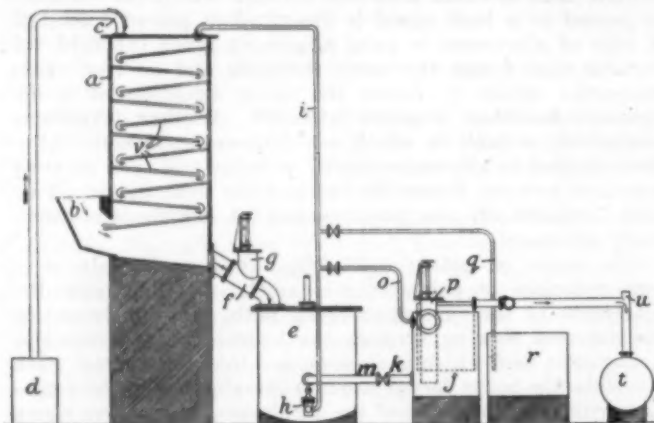
British Patents

For complete specifications of any British patent apply to the Superintendent, British Patent Office, Southampton Buildings, Chancery Lane, London, England.

Fire Extinguisher.—A fire extinguisher contains a self-propelling mixture of methyl bromide with another liquid or other liquids having vapor pressures below atmospheric pressure at normal atmospheric temperatures, such as carbon tetrachloride, trichlorethylene or dichlorethylene, the methyl bromide being sufficiently volatile to cause the mixture to be self-propellant. The liquid may be discharged from the container by means of a valve, etc., or by snapping off a tube which may be indented or cut for this purpose, the end being sealed by flattening it and bending it over after the container has been charged. (Br. Pat. 172,573. A. Henning, London. Feb. 1, 1922.)

Material for Handling Molten Glass.—Apparatus for handling or working molten glass is made of a metal or alloy having a high melting point, not evolving gas when heated and forming an adherent and insoluble coating of oxide which protects it from attack by the molten glass. Alloys of chromium or aluminum with iron, cobalt, and nickel are mentioned. An alloy of 60 per cent iron with 40 per cent chromium in particular is suggested. (Br. Pat. 172,610. Naamlooze Vennootscap Philips' Gloeilampenfabrieken, Eindhoven, Holland. Feb. 1, 1922.)

Sodium Thiosulphate.—The production of strong solutions of thiosulphate from which the salt is crystallized without any evaporation as described in specification 12,599 (1915) is carried out by simultaneously forming sodium sulphite from sodium carbonate and sulphur dioxide, and digesting the sulphite with sulphur, sodium carbonate being prefer-



ably maintained in small excess throughout. Sulphur dioxide from a burner *d* is admitted by a pipe *c* to the top of a tower *a* having shelves *v* down which flows sodium bisulphite solution which contains some sodium carbonate or bicarbonate. Sodium carbonate and sulphur are charged in at *b* where carbon dioxide and nitrogen escape. The reaction mixture passes by a pipe *f* carrying a froth destroying device *g* into a digester *e* which may be jacketed for heating or cooling, and is provided with a stirrer.

Liquor from the digester *e* is raised by a pump *h* and supplied by a pipe *i* to the top of the tower *a*. From the pipe *i* a portion of the liquor may be withdrawn by a pipe *o* and fed through a froth-destroying device *p* to a filter tank *j*, but normally the liquor in the digester *e* is circulated to and from the tank *j* through pipes *m*, *k*, under the action of a stirrer. In the tank *j* a number of vacuum filter plates of known form hang, clear solution being withdrawn from the interior of the plates and led to a store tank *t*. The vacuum pump is connected with a pipe *u*. The liquor may be withdrawn from the apparatus by a pipe *q* to an auxiliary filter tank *r* when it is desired to remove accumulated impurities, such as sodium sulphate, which are insoluble in the thiosulphate solution, but alternatively a proportion of the solid materials separated on the filter plates may be continually withdrawn and rejected. The froth-destroying devices consist of a tubular part containing a spindle carrying disks which are perforated and carry downwardly directed vanes to direct

the liquid particles downward. (Br. Pat. 172,858. L. Hargreaves and A. C. Dunningham, Middlewich, Cheshire. Feb. 8, 1922.)

Calcium Carbide.—Agglomerates for subsequent conversion to calcium carbide are manufactured by heating a mixture of limestone with pitch, heavy oils or like heavy hydrocarbons to a temperature above 700 deg. C. for a period from 20 to 40 hours. The limestone is preferably ground before mixing and the heating is continued until the carbonization is complete. The preferred form of retort enables the carbonization to take place continuously and the gases used to heat the retort are pre-heated by utilizing the heat evolved by the cooling agglomerate. By spraying the latter with a mixture of hot tar and pitch or by introducing coal or coke-oven gases or some hydrocarbon into the retort during the last part of the carbonization, the agglomerate is protected from moist air during storage by a deposit of carbon produced by the splitting up of the hydrocarbon present. (Br. Pat. 172,685. Alby United Carbide Factories, Ltd., London. Feb. 1, 1922.)

Hydrochloric Acid.—In the manufacture of hydrochloric acid by direct combustion of hydrogen and chlorine, an igniting safety flame, preferably produced by burning a mixture of hydrogen and chlorine, is provided at the junction of the streams of the entering gases, which are so arranged as to cause the combustion to take place in a downward direction. The main gas supply is controlled in order to give equimolecular proportions of hydrogen and chlorine. A shaft furnace having means for cooling the walls may be employed for the process and the gases are introduced at the top through two sets of pipes, the one pair surrounding the other. The larger and outer pair supply the main flame and the inner pair supply the small safety jet with hydrogen and chlorine. To effect complete combustion, the reaction gases are passed preferably after partial cooling over or through contact material placed at the lower end of the furnace and consisting of brick, chamotte, pumice, quartz lumps, etc., with or without metals or metal salts acting as chlorine carriers. The resulting hydrochloric acid is withdrawn at the bottom and passed to absorption vessels. (Br. Pat. 173,300. Badische Anilin & Soda Fabrik, Ludwigshafen on Rhine. Feb. 15, 1922.)

Aluminum Salts.—The invention relates to the precipitation of iron from impure solutions of alumina in mineral acids by partly neutralizing the solution in the presence of iron oxide, which acts catalytically. The iron oxide, after being used, is re-activated by treatment with dilute acids or with an acid solution of alumina having a higher hydrogenion concentration than that necessary for the complete precipitation of the iron present. The solution from which the iron is to be removed may be used for this purpose, the iron being subsequently completely precipitated by neutralizing, or by expelling acid by evaporation. The activating process may also be combined with the dissolution of the raw aluminous material in acid. Active iron oxide is introduced during the dissolution of the raw material in acid and the quantities are so regulated that the hydrogenion concentration is too great for complete precipitation of the iron but is sufficiently low to cause reprecipitation of most of the iron that has been dissolved. Thus active iron oxide is produced, so that if the raw material contains sufficient acid-soluble iron, when the process has once been started no further addition of iron oxide is necessary. (Br. Pat. 172,944; not yet accepted. Aktieselskabet Labrador, Christiania. Feb. 8, 1922.)

Extracting Copper.—Copper is extracted from its oxidized ores or other oxidized products by converting the oxidized copper contents into cement copper by the action of a reducing agent on a pulp comprising a mixture of the crushed ore or product, water and an acid or salt. Finely crushed ore may be mixed with water, finely divided iron and a small proportion of ferrous sulphate, sulphuric acid or a mixture of ferrous sulphate and common salt, and steam blown through the mixture; or such a mixture containing sulphuric acid may be allowed to stand for some days. The separation of the resulting copper from the gangue and slime may be effected by settling, flotation or other means.

Aluminum or zinc may be used as a reducing agent instead of iron. In some cases a medium such as an acid which has been used for one precipitation may be utilized as a salt solution for subsequent precipitations. (Br. Pat. 172,926; not yet accepted. P. W. Nevill and H. Soanes, Perth, Western Australia. Feb. 8, 1922.)

Refining Anthracene.—Crude anthracene is purified by dissolving it in hot cresols or the mixture of phenol and cresols known as 60 per cent phenol, cooling and filtering and washing the separated anthracene with petroleum ether. Carbazol may be separated from the anthracene so purified by dissolving the anthracene in hot pyridine, cooling, removing the separated anthracene and distilling the pyridine solution to recover the carbazol. The carbazol may be purified by crystallization from toluene and sublimation. (Br. Pat. 172,864. A. Kagan, Brighton, Feb. 8, 1922.)

Book Reviews

THE PRACTICAL CHEMISTRY OF COAL AND ITS PRODUCTS. By A. E. Findley and R. Wigginton. London: Benn Brothers, Ltd. 140 pp., 23 figures. Price 12s. 6d. net.

The authors indicate that the purpose of this work is to present "one reliable method for determination," including particularly those needs of testing which were taught in the course of fuel technology at the Sheffield University. Teachers of gas and fuel analysis will for this reason doubtless find the book of considerable interest, particularly suggestive of those methods which they should include in their own courses.

The volume is not at all suited to general reference use for the industrial laboratory or for the chemist at gas works or coke ovens in this country. For such workers the volume by A. H. White on the "Technical Gas and Fuel Analysis" or the forthcoming "Gas Chemists' Handbook" of the American Gas Association are distinctly superior. The present volume is much too brief and written from entirely the wrong point of view to serve the commercial or industrial laboratory for which the two other works cited are so admirably prepared.

R. S. MCBRIDE.

* * *

PRECIOUS METALS (LES METAUX PRECIEUX). By Jean Voisin. Encyclopédie de Chimie Industrielle, Librairie J. B. Baillière & Fils, Paris, 1922. 264 pp. illustrated.

The first volume of the Encyclopédie de Chimie Industrielle (see CHEM. & MET., Dec. 21, 1921, p. 1153) to reach us is that of "Les Métaux Précieux" by Jean Voisin. The author has treated the subject from the point of view of their properties, industrial applications and their economic rôle. The six chapters deal respectively with:

Chapter I, Gold, pp. 1-63, in which are summarized the physical and chemical properties, a brief description of the occurrence of native gold and gold ores, a description of the metallurgical treatments and refining.

Chapter II, Silver, pp. 64-111, in which is followed the same plan as in the chapter for gold.

Chapter III, Platinum and Platinum Group Metals, pp. 112-135, containing brief descriptions on the metals platinum, iridium, palladium, rhodium, osmium and ruthenium.

Chapter IV, pp. 136-151, is a very interesting review of the past and present economic rôle of precious metals.

Chapter V, pp. 152-205, deals mainly with assaying the precious metals used for coinage and jewelry.

Chapter VI, pp. 206-239, contains succinct descriptions of the production of precious metals, salts, gold and silver plating, applications to electrical industries, medicinal uses, photography and platinum as catalyzers.

The bibliography, pp. 241-256, is divided into four distinct groups—namely, (1) historical, (2) physical and chemical properties, (3) mining and metallurgy and (4) refining and applications.

J. S. NEGRU.

ALUMINIUM AND ITS ALLOYS. By C. Grard, translated by C. M. Phillips and H. W. L. Phillips. 184 pages, 17 plates and 83 figures. New York: D. Van Nostrand Co. Price, \$5.

"Aluminium," by Grard, is a book for discriminating readers, but they should be able to discriminate between the aluminum and the dross which, unfortunately, clings to the book in spots. One's criticism of the work is tempered, however, by the fact that there is somewhat of a dearth of authoritative books on the subject, and this book is a creditable effort to supply the existing demand for information on the properties and heat-treatment of aluminum and its alloys. According to the title page, the subject is "Aluminium and Its Alloys; Their Properties, Thermal Treatment and Industrial Application," and the principal shortcomings of the book may be traced to the fact that the author's data and selection of data are inadequate to cover the field outlined.

The method of producing aluminum is tossed off in six pages, and statistics on the world's production in another six pages. One wonders, in reading the description of the physical properties of aluminum on page 15, whether the same kind of judgment as used there was exercised in selecting data for the succeeding sections of the book. For example, the atomic weight of aluminum is given as 26.9 instead of 27.0, the thermal conductivity as 36 (silver=100) instead of 51 or 52, and the melting point as "about 650 deg. C," which latter figure is not a very close approximation to 658, considering the state of the art of pyrometry. On a succeeding page the argument would have been just as strong if the melting point of alumina had been given as 2,050 deg. C. instead of 3,000 deg. C. It would have been a kindness for the translators to have called these and sundry other errors to the author's attention in preparing this edition.

In discussing the mechanical properties of aluminum, the author is more at home, and presents some very interesting data obtained for the French Aéronautical Service at various governmental and private laboratories. Quite a comprehensive series of data on the working and annealing of aluminum is given. The author's conclusions with respect to cold work might have been modified if he had obtained more data. The statements that "the maximum cold work, beyond which deterioration and disintegration may set in, is reached when the tensile strength is approximately doubled" and "that 200-300 per cent cold work is the maximum for the working of aluminum" are scarcely precise, to say the least. The tensile strength of aluminum will still be found increasing when the cold work has passed 4,000 per cent as cold work is defined by the author (ratio of the reduction in area to the final area). Aluminum sheet having about 900 per cent of cold work, as thus defined, is a commercial article. The author's curve is defined by four points at 0, 50, 100 and 300 per cent cold work.

In the annealing experiments, the temperatures of the specimens were controlled by immersion in an oil bath or a bath of fused salts. Such a method is much superior in point of precision to the more customary method of heating in an oven or air bath, and the results are correspondingly more reliable.

The second half of the book is devoted to the alloys of aluminum. A useful description of the properties of the aluminum-copper, aluminum-zinc-copper and aluminum-magnesium alloys, as cast, is followed by a section on the heat-treatment of aluminum alloys containing copper and magnesium. The last section of the book deals with the copper-rich aluminum alloys commonly called the "aluminum bronzes." In the appendix will be found the French Aéronautical specifications for high-strength aluminum alloys.

The book is a useful contribution to the metallurgy of aluminum, and is particularly interesting as reflecting the experience and experiments of the French Aéronautic Service. It is not, however, an authoritative work, for the reasons above indicated.

JUNIUS D. EDWARDS.

Technical News of the Week

Current Events in the Chemical, Metallurgical and Allied Industrial Fields—Legislative Developments—Activities of Government Bureaus, Technical Societies and Trade Associations

No Shortage of Nitrates for Fertilizer, Says Secretary of Agriculture

A statement of the Secretary of Agriculture in reply to a telegram sent to him by Andrew L. Felker, Commissioner of Agriculture for New Hampshire, states his opinion that there is no shortage of nitrates among the fertilizer companies. Mr. Felker complained that fertilizer companies are unable to get nitrates to fill farmers' fertilizer orders and as a result the latter are seriously handicapped. Secretary Wallace replied in part as follows:

"I am not able to understand the basis for the belief that there is a serious shortage of nitrates and that fertilizer companies are not able to supply fertilizer needs of farmers because of this shortage. Apparently, from the record of imports during the past two years, there has been no shortage of nitrates. The normal importation of nitrate of soda before the war was about 600,000 short tons, and I am told that of this about 250,000 tons were used for fertilizers. In 1920 we imported 1,480,519 short tons of nitrate of soda, or something more than a two years' normal supply. This would have supplied the demand for fertilizers for 1920 and for 1921 and leave a surplus of approximately 200,000 tons for 1922. The fertilizer tonnage for 1921, however, is believed to have been little more than one-half the expected tonnage, and it is therefore reasonable to believe that the nitrate surplus for 1922 was considerably more than 200,000 tons.

"In 1921 nitrate of soda imports amounted to 413,474 short tons. In that year also the War Department released 80,000 tons, making available during that year 493,474 tons, in addition to the more than 200,000 tons of surplus presumably carried over from 1920. In January and February of this year we imported 32,065 short tons. There has been no lack of available nitrate of soda in Chile, for on June 30, 1921, there was said to be a visible supply of 2,435,000 long tons, while the most hopeful estimate of the world demand was about 1,600,000 long tons.

COMPANIES DO NOT BUY WAR DEPARTMENT SURPLUS

"Now, as to the statement that fertilizer companies are not able to buy nitrates, permit me to call your attention to the fact that on Thursday of last week the War Department offered at public sale 40,000 tons of nitrate, the conditions being that in quantities of 500 tons or more the War Department might reserve the right to demand an equivalent amount of nitrates within ninety days, but sales of less than 500 tons would be considered final sales. I am told that a large number of representatives of fertilizer, powder and chemical companies attended this sale in Washington. In all there were about 11,000 tons definitely sold, but from the report of the sale evidently less than 2,000 tons were bought by fertilizer companies, the remainder of the 11,000 tons going to chemical and powder companies. I do not know why fertilizer manufacturers who are complaining of the difficulty of getting nitrates did not attend this sale and buy when they had an opportunity. One company made a bid for 23,000 tons under the condition which gave the War Department the right to demand repayment in nitrates, but the price bid was considered by the War Department altogether too low, and I am informed that this sale was canceled.

"Reasoning from the statistics quoted in the foregoing, I think you must agree with me that apparently there is no shortage of nitrates to meet the needs of fertilizer manufacturers. Had there been such shortage as seems to be indicated by your telegram it would seem that fertilizer companies would have taken advantage of the offerings of the War Department last week."

Rival Muscle Shoals Offers Discussed—Farm Bloc Backs Development

In testimony before the Senate Agricultural Committee, T. W. Martin, president of the Alabama Power Co., emphasized that the proposal submitted by his company conforms with the provisions of the Federal water power act and if given a lease, the company would operate under the supervision of the Federal Power Commission. The company has prepared a pamphlet embodying the terms of the offer and the letters of comment by Secretary Weeks and Mr. Martin.

The agricultural bloc of the Senate, composed of an influential group of Senators determined to secure legislation in the interest of the agricultural industry, and which has heretofore scored numerous legislative successes, has come out strongly for the development of the nitrate project. In a Senate speech, Senator Capper, of Kansas, chairman of the bloc, said the organization favors the development of the project, as it will contribute to a permanent and prosperous system of agriculture. He believes that work should be resumed on the fertilizer and power plants on the Tennessee river, and says it is possible to reduce the nation's fertilizer bill from \$250,000,000 to \$125,000,000 if the Muscle Shoals program is carried out.

One of the first decisions reached by the House Committee on Military Affairs was to eliminate Dam No. 3 and the Gorgas steam plant from any present consideration. It is the intention of the committee to present an inventory of all unencumbered property which the government has at Muscle Shoals. This list, along with certain decisions of the committee, will be presented to those who have made bids and each will be given an opportunity to modify his offer to conform. The committee now is engaged in an examination of the Ford offer.

Speaking before the Kiwanis Club in Detroit, Ernest G. Leibold, personal secretary to Mr. Ford, dwelt on the theme that the world has reached a stage where gold can no longer function as an international medium of exchange. He pointed out Mr. Ford's scheme to raise the \$30,000,000 for the completion of the project by the issuance of special currency which will be retired in 25 years by the accumulating 4 per cent interest that Mr. Ford wishes to pay annually, "without one dollar of interest having been taxed on the public."

Structural Steel Society Disbands Because of Depression and Government's Attitude

After 11 years of activity the Bridge Builders and Structural Society will disband at the end of this month, according to a recent announcement from its headquarters in New York. The society has been one of the so-called open-price associations whose purpose has been to spread the information among members of the prices at which the structural steel fabrication projects were taken. The decision to disband was made because of doubt as to the government's attitude toward the society and its practices and to the depression in the steel industry in 1921. Besides the open-price discussions, one of the activities of the society has been the gathering of monthly statistics as to the amount of fabricated steel contracted for throughout the country. These figures are taken by steel experts as one of the barometers of the steel industry. The Structural Society has volunteered to continue this latter work.

The decision to disband has been known in inner circles for several weeks. Prices have not been exchanged since the first of the year. The membership embraced the leading independent steel fabricators.

Regulating the Activities of the Trade Association

Of late the attention of the business public has been focused on the trade association. It has been recognized as an element of growing importance in our industrial program, but with this realization has come the need for a better understanding of its activities, particularly those in which perplexing legal questions are involved. The discussions in the newspapers and technical press by lawyers, economists and business men have served to clarify certain of the relations of the trade association to industry. It remained for the recent Trade Association Conference held under the direction of Secretary Hoover to emphasize the desirability for defining the government's relation to the trade association.

THE EDGE-McARTHUR RESOLUTION

It was with this in view that Senator Edge of New Jersey and Representative McArthur of Oregon introduced legislation in Congress for the purpose of definitely establishing the status of the trade association. They proposed a Congressional investigation by a commission composed of three Senators and three Representatives which by next December should report legislation defining the rights and limitations of co-operative organizations as distinguished from illegal combinations in restraint of trade. The resolution points out that business is now hesitating because it is unable to secure guidance which will clearly indicate proper lines of conduct.

The Edge and McArthur bills, which supplement their joint resolution, propose that trade associations shall be under the jurisdiction of the Federal Trade Commission. Unless excused by it, each association would be required to file with the Federal Trade Commission a statement of its general character and proposed activities, the names and addresses of its members, officers, minutes of meetings and resolutions or agreements, expressed or implied, whether between members of the association or between the association or its members and others.

The bills would also require trade associations to file with the commission statistics collected by them as to production, shipments, stocks, contracts, prices, credit information, and all others respecting the trade. The commission may, if it sees fit, give publicity to such statistics for the public interest, and unless prohibited by the commission the association may distribute among its members statistics which have been filed with the commission.

RESOLUTION IS SIDETRACKED IN SENATE

The resolution was introduced to the Senate on April 17, but met with considerable opposition. Senator King of Utah expressed the fear "that the business men and manufacturers of the country, profiting by their experience in the war, when we winked at combinations in restraint of trade and destructive of competition, want to perpetuate that condition and want the government to modify the Sherman anti-trust law so that they may organize to throttle and destroy competition and build up gigantic monopolies."

Senator Hitchcock, failing to see the need for the investigation, declared that no other of our laws has been as thoroughly defined by the courts of the United States as the anti-trust law. Senator Edge contended, however, that the Supreme Court's decision in the case of the Hardwood Manufacturers Association has left industry in a state of acute legal and economic uncertainty.

Further opposition was developed by Senator Cummins, who had helped to frame the original Federal Trade Commission act. Finally Senator Walsh of Montana urged that the resolution should be referred to the Judiciary Committee, and since there was no objection it was so ordered.

On April 19 the resolution was again brought up, but by a vote of the Senate it was displaced by other business. Senator Edge then gave notice that he would ask the Judiciary Committee to hold public hearings on his bill. It is reported, however, that Chairman Nelson of the Judiciary Committee is not inclined to order hearings at

this time, in which case there is but little chance of the resolution being revived.

GAINS FROM OPEN-PRICE ASSOCIATIONS ARE GREATLY EXAGGERATED

Trade association practices which come under any suspicion whatever constitute such a small percentage of the benefits accruing from the work of these organizations that there is no justification for the continuance of questionable activities. This point was brought out strongly at the Trade Association Conference held at the Department of Commerce. It was shown that only seventy out of 3,000 organizations can be classed as out and out open-price associations. Even among the open-price associations the opinion was expressed that 90 per cent of the benefits to members come from other activities. One of the conclusions that may be drawn from the meeting is that the value of so-called open-price statistics has been exaggerated.

While it was brought out clearly at the meeting that the legality of open-price statistics has not been passed upon and that associations doing such work cannot be denounced as lawbreakers, particularly when their figures are made public, yet it was made perfectly plain that the Department of Commerce will not co-operate with that type of organization. No one will be surprised if the Department of Justice should institute proceedings against such associations. At any rate, the Department of Commerce is not going to jeopardize its usefulness to other trade associations by co-operating with those which are operating within the twilight zone.

HOOVER FAVORS PUBLICITY BUT NO GOVERNMENTAL CONTROL

In this general connection, those high in authority are impressed particularly with the inhibition against secrecy which runs through the opinion of the Supreme Court in the Hardwood Lumber case. Since the Supreme Court seems to aim particularly at statistics which are available to members only of associations, the Department of Commerce is interested in giving evidence that publicity is taking place. There is no desire on the part of the department, Secretary Hoover points out, to force any association to file its figures with his bureaus. In fact the department is entirely out of sympathy with legislation giving actual control over any trade association activity. There are a few instances, one of which is in the chemical industry, where statistical information as to important basic commodities is refused by manufacturers. It is admitted that legislation may be required to remedy that situation.

The Department of Commerce has on file a long list of the constructive things which trade associations can do. The list is growing. It is believed that its growth will be accelerated as trade associations realize that they have been covering only a portion of their field. Heretofore attention has been concentrated largely on matters intended to accelerate production. Very little has been done toward improvement in distribution—an area that should be closely studied. Sight also seems to have been lost of the fact that no restraint of trade is involved when buyers and sellers get together. Were trade associations to arrange for committees of buyers to confer with committees of sellers, it is believed that much waste could be eliminated and the spread between the price obtained by the producer and that paid by the ultimate consumer could be narrowed materially.

Chemical Plant Equipment Manufacturers Meet to Organize Association

Plans for the organization of an association of chemical plant equipment manufacturers will be consummated at a meeting to be held at the Chemists' Club, New York, on May 10 at 10 a.m. After completion of the details of organization, plans for future activity will be discussed, at which time representatives of the Chemical Exposition, the Boston Textile Show, the New York Automobile Show and the Ice Cream Supply Dealers' Association will be heard. Representatives of firms who may become members of the new organization are invited to be present at these meetings.

Patent Working Clause Hearings Postponed

Hearings on pending legislation requiring the operation of patents which were scheduled to reopen before the Senate Patents Committee on April 18 have been postponed to a date to be announced later. The explanation offered is that with the tariff bill before the Senate members of the committee cannot take the time to study such an important proposal as is embodied in the Stanley bill.

Original Purpose of Dye Investigation Lost In Discussion of Embargo System

Sight seems to have been lost of the monopoly charges made against the domestic dye industry in the investigation being conducted by the Shortridge sub-committee of the Senate's Judiciary Committee. During the past week the hearing has resolved itself largely into a discussion of the respective advantages and disadvantages of the selective embargo system.

The questions asked consumers of dyes usually reveal that the witness is impelled by a desire to get dyes at the lowest possible price. These witnesses frequently are embarrassed by efforts to explain their position. If they were allowed to take advantage of the prices Germany is willing to make at this time, it is brought out repeatedly, they soon would be left to the tender mercies of the manufacturers in that country, who would not be restrained as they were formerly by the fear of possible American competition. If after all the expenditure of capital and effort and after the advantages which have come from 8 years of embargo, it is found impossible to build up a dye industry in this country, it is certain no other effort will be made if this one fails. It has been brought home to the consumers of dyes several times during this hearing that instead of placing obstacles in the way of the development of the domestic industry, they above all others should be interested in encouraging whatever steps are necessary to insure its permanency. Witnesses for the consumers dislike to talk about the value of the dye in relationship to the selling price of the article into which it enters. One witness refused point-blank to put such prices into the record. In several instances these witnesses were not closely in touch with the situation. The American control over imports was blamed for delays caused by the strikes in Germany. On the whole their testimony has been theoretical.

TEXTILE REPRESENTATIVE DENOUNCES EMBARGO

Ward Thoron, treasurer of the Merrimack Manufacturing Co., of Lowell, Mass., and Huntsville, Ala., manufacturer of plushes, velveteens, corduroys, moleskins and fustians, declared that the embargo puts an intolerable burden on the textile trade. He expressed the conviction that unless the dye industry can get along without the embargo and licensing system, the American dye users cannot afford to continue to patronize it. "American manufacturers must abandon the dyes they cannot make without more protection," he said. "I don't object to a tariff of 100 per cent protection," continued the witness, "but I do object to the license and embargo system. If these people can't manufacture at 100 per cent protection, let them perish."

When the witness was requested to show the proportion of the cost of dyes to the selling price of his goods, he declared, "That I absolutely refuse to do. It has nothing to do with the costs. The selling price varies from time to time and depends upon supply and demand."

Senator Shortridge attempted to bring the testimony back to earth by asking the witness his opinion as to the existence of a monopoly, but his ideas on this subject seemed vague.

Mr. Thoron said that a group of Massachusetts textile men had, in July, 1921, addressed a circular to a number of dye users asking their opinion on the embargo system. The result was sixty-three replies against and thirteen in favor of the selective embargo system. "Frankly," he added, in closing his testimony, "I dislike the teamwork among the Chemical Foundation, the bureau of investigation of the Alien Property Custodian's office, the Textile

Alliance and the American Dyes Institute with the dye manufacturers. It augurs no good to the dye users."

F. S. Dickson, head of the dye and chemical section of the customs division, Treasury Department, expressed the opinion that some of the complaints of the textile men against the embargo were due to lack of funds to maintain a laboratory and a trained technical staff. Mr. Dickson thought that some arrangement might be worked out later whereby importers might keep surplus stocks of foreign dyes on hand.

KING STILL WANTS EXAMINING COUNSEL

A letter was read into the record from Senator King in which he reiterated his statement that the committee should have counsel to examine witnesses and mentioning Samuel Untermyer as the logical man for the job. Senator King also replied to suggestions that he should cross-examine witnesses himself, saying that he doubted the propriety of such a procedure, inasmuch as he had introduced the resolution calling for the investigation.

CHARGES OF FALSIFIED INVOICES AGAINST I.G.

Charges, accompanied by documentary evidence, that the German dye monopoly has falsified consular invoices for the purpose of furnishing dyestuffs to importers in this country at prices less than those charged for the reparations dyes by the Textile Alliance are contained in a letter under date of April 11 from A. M. Patterson, president of the Textile Alliance. Under the emergency tariff, duty on the reparations dyes is assessed on the home consumption price or the export price, whichever is higher. It is therefore necessary to have the German manufacturers certify in the consular invoices the export price, as well as the home market price. By certification of erroneous prices in the consular invoices, the dyes were subject to excess duties for overvaluation and penalties for undervaluation, neither of which is recoverable.

The letter submitted consular invoices of the Bayer Co. showing that the company sold alizarine blue-black B to the Textile Alliance at \$2.85 per kilogram but to a United States importer at \$1.87. The shipment to the importer was undervalued and a similarly worded invoice with different figures and signed by the same signature of the Bayer Co. was sent to the Textile Alliance.

KNITTING MILLS NOT REPRESENTED IN ALLIANCE

George Deming, counsel for the National Association of Hosiery and Underwear Manufacturers, appeared in opposition to the embargo. Mr. Deming will be remembered as having handed Senator Shortridge a letter attacking the conduct of the hearings some weeks ago. The substance of this letter was later repudiated by J. N. McCullaugh, manager of the association.

The two principal reasons for his clients' opposition to the embargo are, first, that it increases production costs and, second, that there is no sound justification for singling out the dye and organic chemical industry as the only beneficiary of special protection. If the embargo is applicable to the dye and chemical industry, it is more applicable to other American industries, he declared.

In answer to questions, Mr. Deming said he believed that competition exists among manufacturers at the present time, and that the administration of the embargo is honest and plays no favorites.

Mr. Deming's testimony was interrupted several times by Samuel Isermann, president of the Chemical Co. of America, who demanded to know who pays the witness. The lawyer replied that he was not paid by the association but by some of its members and other consumers of dyes. The embargo was attacked by the witness as hampering, restrictive and involved with red tape. He also attacked the Textile Alliance, declaring it presumptuously took upon itself the self-imposed task of speaking for the entire textile industry when from 2,600 to 2,700 knitting mills, constituting an important part of the textile industry, were not represented in the Alliance.

Some of Mr. Deming's remarks precipitated a discussion as to the quality of American dyes, Dr. Isermann declaring that American dyes are at least equal in quality to any others for dyeing hosiery.

Infringement Suit on Stainless Steel Against Ludlum Steel Co. Dismissed

The suit of the American Stainless Steel Co., of Pittsburgh, alleging infringement by the Ludlum Steel Co., Watervliet, N. Y., of the Brearley and Haynes stainless steel patents, has been dismissed by the United States District Court at New York. The court on April 13 issued a lengthy decision dismissing the complaint on the ground that no infringement was shown.

The Brearley and Haynes patents cover high-chromium, low-carbon steel for producing stainless cutlery. The Ludlum Steel Co. has patents covering chromium-silicon alloy steel. The Ludlum steel, although high in chromium, contains less chromium than the steels put out under the Haynes and Brearley patents. The Ludlum steel is low in carbon, as are the steels made under the Brearley and Haynes patents, but it runs high in silicon, unlike the Brearley and Haynes steels. In its complaint the American Stainless Steel Co. alleged that the Ludlum company's steel constituted an infringement of the Brearley and Haynes patents, claiming that the addition of silicon was made in order to evade the two patents and had no effect upon the stainlessness of the steel. The Ludlum Steel Co., in defending the action, denied that it used silicon to evade the Brearley and Haynes patents, but claimed that the addition of silicon made the product a different and better one.

The court held that the Ludlum steel without the silicon would not constitute an infringement of the Haynes and Brearley patents; that without the silicon the steel would not become stainless upon hardening as disclosed in the two patents and that the addition of silicon to the steel, while making it stainless, could not create infringement, because the stainless result was obtained by something not disclosed in the Haynes and Brearley patents.

The court did not pass upon the validity of the Brearley and Haynes patents, but merely held that the silicon-chromium steels of the Ludlum Steel Co. do not infringe.

Pittsburgh Meeting, American Society for Steel Treating

Technical sessions as follows are planned for this occasion to be held at the auditorium of the Pittsburgh Station, Bureau of Mines, located in Schenley Park:

THURSDAY, MAY 25, 1:30 P.M.

Professor McIntosh, Carnegie Institute of Technology, "Fiber in Steel and Iron."

W. B. Crowe, metallurgist, Carnegie Steel Co., "Mass Influence on Heat Treating."

FRIDAY, MAY 26, 1:30 P.M.

Mr. Cox, R. D. Nuttall Co., "Abrasive Qualities of Carbon and Alloy Steels."

J. A. Succop, Heppenstall Forge & Knife Co., "The Importance of Properly Heating and Cooling Steel."

Mr. Smith, Union Spring & Manufacturing Co., New Kensington, Pa., "Manufacture of Springs."

Mr. Grossman, Electric Alloy Steel Co., Youngstown, Ohio, "Shrinkage of High-Speed Steels."

A banquet will be held at the University Club Thursday evening, and a smoker at the Bureau of Mines Friday evening. Opportunity will be extended to visit several steel mills and manufacturing plants.

Would Extend Maryland Clay Workings

The Commercial Club, Frostburg, Md., has concluded arrangements with the Bureau of Mines, Washington, D. C., for a complete and exhaustive investigation of clays in Allegany County, particularly in the western section, in the vicinity of Frostburg. Clay from this district has been used for many years past for the manufacture of brick, as well as hollow tile and certain other burned clay products, but it is believed that the forthcoming investigation will indicate a wider range of use for the material, showing the commercial value for other clay products. The clay mines are adjacent to extensive coal properties, making unusually fine plant site conditions.

Western Reserve University Offers Summer Courses in Chemistry

Announcement has been made by the Western Reserve University of a series of courses in chemistry especially designed for teachers and for students desiring work of senior college or graduate grade. These courses will continue for 6 weeks, from June 19 to July 29, and will include studies in general inorganic chemistry, chemistry of the metals, organic chemistry, qualitative and quantitative analysis, chemical microscopy, glass blowing and applied electrochemistry. Further information may be obtained by addressing the registrar, Cleveland School of Education, Cleveland, Ohio.

Harding Shows Interest in Activities of Federated American Engineering Societies

The work of the Federated American Engineering Societies was discussed April 11, when Mortimer E. Cooley, the president of the Federation, and L. W. Wallace, its executive secretary, conferred with President Harding. The President showed keen interest in the organization and recalled the part which Secretary Hoover took in its formation.

Dean Cooley outlined the work that the Federation plans for the immediate future and called the attention of the President to a list of the activities which have concerned the Federation since its foundation, 17 months ago. The list is as follows:

Investigation of industrial waste; participation in the settlement of jurisdictional disputes among unions of the construction industry; study of the relative merits of the eight-hour and twelve-hour shifts in continuous process industries; actively supported Patent Office relief bill; topographic survey bill, business cycle bill, railway transportation bills, and legislation providing a commission status for sanitary engineers of the U. S. Public Health Service; study of the Muscle Shoals and Great Lakes-St. Lawrence waterway projects; participation in the Unemployment Conference's investigation of business cycles; participation in the activities looking to the reorganization of the federal government's executive departments, including the bill providing for a Department of Public Welfare, and particularly proposals looking to the establishment of a Department of Public Works; participation in numerous conferences called by the Department of Commerce.

Institute of Metals

A joint meeting of the Institute of Metals Division of the A.I.M.E. and the American Foundrymen's Association will be held in Rochester, N. Y., June 5 to 9, 1922. (Headquarters at Powers Hotel.) A preliminary announcement of the technical program includes the following:

"Physical Properties of Cartridge Brass," by C. Upthegrove and W. G. Harbert, of the Department of Chemical Engineering, University of Michigan, deals with the effect of annealing and rolling.

"Electrical Properties of Nickel and Monel Wires," by M. A. Hunter, F. M. Sebast and A. Jones, of Rensselaer Polytechnic Institute.

"Blue Constituent in Manganese Bronze," by E. H. Dix, Jr., Air Service, U. S. A., at Dayton, Ohio, shows the effect of this little known constituent as determined by experiments at McCook Field.

"Gas Absorption and Oxidation of Non-Ferrous Metals," by Bruno Woyski and John W. Boeck, metallurgists of the Lumen Bearing Co.

"Testing Artillery Cartridge Cases," by J. Burns Read and S. Tour. It summarizes, as far as possible, the metallurgical information and experience gained by the Ordnance Department during the war on the manufacture of artillery cartridge cases, describes the tests to which the cases were put, and summarizes the knowledge and experience gained in this testing.

Upon publication, copies of these papers will be mailed to interested parties who send a request to the secretary of the Institute, 29 West 39th St., New York City.

N. J. Chemical Society on Record for American Valuation—Harkins Talks on Isotopes

At a well-attended meeting of the New Jersey Chemical Society in Newark, N. J., on April 17, all the officers were re-elected for the coming year by unanimous vote. A lively discussion on the chemical schedule of the tariff bill was precipitated by a resolution introduced by N. W. Haynes, editor of *Drug and Chemical Markets*, urging the adoption of rates based on American valuation. The resolution was amended and adopted in the following form:

"Therefore, be it resolved that we, the members of the New Jersey Chemical Society, do urge upon Congress the adequate protection of the chemical industry by the prompt adoption of tariff schedules on chemicals based upon American valuation except those chemicals already adequately protected by an embargo."

W. D. Harkins, professor of chemistry at the University of Chicago, addressed the meeting on "Isotopes and the Structure of Atoms." Prof. Harkins gave a sketch of developments which led up to the discovery of isotopes and showed a number of photographs of the path of alpha particles emanating from radioactive substances and the disintegration of the atom. He also described the apparatus and method used for isolating the isotopes of chlorine and mercury and showed how the atomic weight of the elements depends upon the number of isotopes which form the atom.

Prof. Harkins explained his whole number rule, which may be stated very simply as follows: The atomic weight of any pure isotope, with the exception of hydrogen, is almost exactly a whole number. It is evident that, if this rule is valid, any element of which the atomic weight is not a whole number must consist of two or more isotopes. With the aid of a chart showing the atomic number and atomic weight of all the known isotopes, he explained the method used for predicting the number of isotopes and their atomic numbers that an element should have.

Prof. George B. Pegram of Columbia University and Prof. George Winchester of the State University of New Jersey led in the discussion which followed.

Tentative Program Announced for Atlanta Meeting of A.S.M.E.

The tentative program for the spring meeting of the American Society of Mechanical Engineers, which is to be held in Atlanta, Ga., May 8 to 11, includes a number of features of interest. Headquarters will be established at the Piedmont Hotel, and numerous social features and excursions to points of local interest will be interspersed in the technical sessions. A discussion of the Muscle Shoals nitrate plant and the nitrogen supply by Major J. K. Clement will feature one of the general meetings. A paper on centrifugal castings will be presented by Leon Cammen at the same session, and W. K. Lewis will submit a paper on the evaporation of a liquid into a gas. Among the subjects scheduled for the power sessions are "Power Development in the Southeast," by Charles G. Adsit, "Economics of Water Power Development," by C. A. Mees, and "New Developments in Hydro-electric Design," by J. A. Sirnit. A symposium on welding will be held at which will be presented a number of papers dealing with the strength of electrically welded pressure containers and other phases of the subject. Plans for the entertainment include a visit to Muscle Shoals.

A.I.M.E. Co-operates With Government in Survey of Mineral Resources

Mining engineers who have specialized in war minerals are to be designated to co-operate with army officers in the study of the strategic mineral situation in the hope that peace-time activities can be directed along lines which will contribute most to the national defense in case of an emergency. The entire subject of war minerals was discussed in Washington last week by Pope Yeatman, J. E. Spurr, George Otis Smith, H. Foster Bain and Arthur S. Dwight, who are members of the committee of the American Institute of Mining and Metallurgical Engineers requested to co-operate with the War Department.

New Infringement Suits by Patentee Claiming Interest in Minerals Separation Patent

Infringement suits have been brought against the Kenecott Copper Co., the Nevada Consolidated, Ray and Chino companies, with home offices in Maine, and Federal Mining & Smelting, Belmont & Wagner, Calaveras Copper Co., and Miami Copper Co., Delaware corporations, by J. W. Wolf, for infringement of his patent No. 787,814, April 18, 1905.

It is explained that the delay in bringing infringement suit until within a few days of the expiration of the patent has been due to the fact that Mr. Wolf was financially unable to undertake the prosecution of such suits, and also that it had not been possible for him to ascertain the facts as to the operations of those who had been using his process.

A few months ago Mr. Wolf brought a suit against his financial principals, alleging that it was through their failure to carry out the terms of their contract that he was deprived of enormous royalties which were then being paid to others—namely—Minerals Separation, Ltd. It is an interesting fact that Mr. Wolf went to Sulman & Picard, as consulting independent engineers, to have them develop the details of an improvement in bulk oil process for the use of sulpho-chlorinated oils, in the year previous to the issuance to Sulman, Picard and Ballot of the now famous Minerals Separation patent.

More Engineers Being Employed

Distinct improvement in the unemployment situation in the engineering profession is reported by the Federated American Engineering Societies' Employment Bureau, 29 West 39th St., New York. During the first quarter of this year 778 available positions were sent to the bureau, as against 347 for the same period in 1921. The number of men placed showed an increase of 41 per cent, rising from 293 during the first 3 months of last year to 415 during the quarter just passed. The number of new men registering with the bureau fell from 552 last year to 421 during the first 3 months of this year.

Many of the positions available are in the junior grades, but there is an increased number noted in the higher grade openings which are sent in, practically unheard of at the same time last year.

The gradually increasing activity does not appear to be confined to any particular line, but is more or less general. The architectural field seems to be fairly busy, and building construction shows somewhat of an onward trend. General manufacturing indicates slow improvement. There are many large projects which are rapidly reaching the definite stage, and some big work will probably be opened up within the next few months.

It is stated that business men are gradually realizing that the engineer is not a narrow specialist, but is a trained man capable of handling a non-technical job.

English Ceramic Society Plans Tour Through Scandinavian Pottery Plants

The Ceramic Society of England has arranged a tentative program for its foreign trip to Sweden and Denmark which is to take place from May 27 to June 10, 1922. The trip will include visits to potteries at Gothenberg, the power plant, carbide, graphite and smelting plants at Trollhättan, "the Swedish Niagara Falls," and the works of the Kopparbergs Bergslag, which is the largest private works in the country and manufactures iron, steel, paper, copper and timber. Visits will also be made to the universities and schools at Upsala and Stockholm and the pottery plants in this vicinity. The refractory brick plants at Höganäs and near Copenhagen will entertain the visitors, as will the china works around the city. The party will return to England from Copenhagen.

A special train will be provided to carry the party from town to town, so that early morning starts will not be necessary. Considerable time is left open so that members will have opportunity to visit points of individual interest.

French Societies Move to Assure Funds for Compilation of Annual Tables

The confederation of French scientific societies has renewed for the year 1922 its contribution of 40,000 francs in support of annual tables of constants and physical, chemical and technological data. The total subscription in France to this project during the year 1921 was 80,000 francs.

At the approaching meeting of the International Union of Pure and Applied Chemistry which is to be held at Lyons in June, the matter of organizing the work of annual tables upon a solid financial basis will come up for consideration. This important international project has had a very precarious existence since 1914 and the fact that the work has been continued at all has been due to the efforts of the general secretary, Dr. Charles Marie. Plans for providing a certain and sufficient budget for the work during the next 5 years are in preparation, based upon definite annual contributions from the various countries in the International Union.

Fellowships in Mining and Metallurgy Announced by University of Utah

Announcement is made by the department of mining and metallurgical research of the University of Utah of a number of fellowships in that department during the year 1922-23. This department is maintained in connection with the Utah Section of the United States Bureau of Mines and is a department of co-operative research maintained by these two organizations. The problems which are to be continued during the coming year include ore-dressing problems dealing with crushing and flotation, study of the chemical reactions involved in the chloridizing roasting, oil-shale technology, hydrometallurgy of zinc and problems inherent in the chloridizing volatilization process, including equilibrium measurements and fume treatment.

These fellowships are open to college graduates with a good training in chemistry and applications will be received for them up to May 15, 1922. Applications should be addressed to J. F. Merrill, Salt Lake City, Utah.

Newly Organized Company Will Erect Large Pulp and Paper Mill in Canada

The Bathurst Company, Ltd., has been organized with a capital of \$3,000,000 for the purpose of taking over 200 square miles of timber limits, east of Prince George, B. C., and establishing a paper and pulp factory that will have an output of 150 tons per day and will give employment to close to 1,000 men. Among those interested in the new organization are Angus and H. K. McLaren, of Montreal; Frank Jones, of the Canada Cement Co.; Peck Bros., of Pennsylvania and Lord Beaverbrook, who owns the *Express* and several other papers in England. The construction of the plant is to be started about June 1. The organization of the company has been in contemplation for some time, and a number of concessions have been obtained from the British Columbia Government. When completed it will be the largest single pulp and paper concern in the province.

New Bureau of Mines Publication on Preparation and Uses of Tar

The issuance of Technical Paper 268, "Preparation and Uses of Tar and Its Simple Crude Derivatives," by W. W. Odell, fuel engineer, is announced by the United States Bureau of Mines. This paper discusses the uses to which some of the various tars are put and shows briefly the usual methods of working up tar into some of its simple or easily prepared derivatives. Although coal tars are given chief consideration, the properties and characteristics of water-gas tar are mentioned. This publication is not a handbook on tar distillation, but is published by the Bureau of Mines as a general treatise on the utilization of tar.

It may be obtained by addressing the Bureau of Mines, Washington, D. C.

New Power Map of Pennsylvania Shows Stations and Lines of Public Utilities

A map of Pennsylvania showing the location of the power stations and electrical transmission lines used by public utility companies has just been published by the United States Geological Survey, Department of the Interior.

This map is the second of a series now being published, that of New York having been recently issued. Two other maps are nearing completion, one covering New Hampshire and Vermont and the other covering Massachusetts, Connecticut and Rhode Island, and maps of Maine, New Jersey, Maryland and Delaware are also in preparation. These maps were prepared in collaboration with the power companies.

The two maps already published may be bought from the Director of the United States Geological Survey at Washington for 50 cents each.

Civil Service Openings for Junior Chemists

The United States Civil Service Commission invites attention to examinations to be held on May 24 and June 21 to fill positions of junior chemist in the departmental service at Washington, D. C., at entrance salaries ranging from \$1,200 to \$1,800 a year. These examinations require written tests in the examination room in addition to a rating on education, training and experience.

Further information regarding the pending examinations and application blanks may be obtained from the United States Civil Service Commission, Washington, D. C., or the secretary of the civil service board at the post office or custom house in any city.

U. S. Chamber of Commerce to Discuss Effect of European Conditions

"European Conditions and Their Effect on American Business" will be the main topic at the tenth annual meeting of the Chamber of Commerce of the United States, to be held in Washington, May 16 to 18. This announcement was made by the Chamber when it made public a tentative program for the meeting.

Because of the interest of business men throughout the country in the general subject it is predicted that the convention will be one of the largest ever held by the Chamber. More than 1,400 business organizations have been asked to send representatives and an attendance of from 4,000 to 5,000 business men is looked for.

New Course in Alloys at Wisconsin

Alloys and alloy steels will be studied intensively by about sixty students in the department of mechanical engineering of the college of engineering of the University of Wisconsin. This subject is included in a new course in metallography. An increasing demand from factories and shops for men who know the heat-treatment of metals and alloys as well as understanding the properties of alloys has brought about the introduction of this new study.

American Fertilizer Association Plans Meeting

The convention committee of the American Fertilizer Association is at work on the business and entertainment program for the twenty-ninth annual convention of the society, which is to be held at White Sulphur Springs, W. Va., the week beginning June 12.

Speakers will address the convention on subjects of importance to the fertilizer industry. Meeting headquarters will be established at the Greenbrier.

Alien Property Custodian Reports Activities

Alien Property Custodian Miller has transmitted to the Senate a detailed report of activities of his office since the declaration of war in the administration of trusts covering alien property, which includes chemical plants among some 33,000 active trusts under control of this agency. The report is in response to a resolution of inquiry by Senator King of Utah.

French Government May Co-operate in Development of Haber Process for Munitions

The Finance Committee of the French Chamber of Deputies is considering a bill relative to an agreement made on Nov. 11, 1919, by the Minister of Industrial Reconstruction and the Badische Anilin concerning the Haber process for synthetic ammonia. Amendments have been proposed by M. Loucheur aiming at the exploitation of the Haber process by a French commercial company, acting for account of the state in the form of an interested administration. The state would interfere directly as little as possible, and the intervention, if necessary, would be limited to the erection of the buildings necessary for the exploitation of the process.

It appeared from the discussion in the commission that the Haber process is to be instituted at the Toulouse powder mill, which will be equipped to produce daily the 100 tons of nitrogen which might eventually be necessary for the defense of the country.

Comparison of National Standards of Mass Made at Bureau of Standards

A comparison of certain platinum and platinum-iridium standards of the Bureau of Standards with the two national standards (kilogram No. 20 and kilogram No. 4) was completed during March and represents the most elaborate work of the kind that has been done by the bureau in many years.

One of the most gratifying features of the work is the complete agreement of the results based on the two national standards, notwithstanding the fact that one of them has been used several times, while the other has not been employed for actual weighing since it was received from the International Bureau of Weights and Measures in 1889.

About an equal number of weighings was made in determining the actual values of some of the gold-plated bronze standards. The computation of these results is not entirely complete, but it is evident that they will not be quite so accurate.

Personal

HARRY EASTWOOD, formerly with the American Radiator Co., Kansas City plant, is now research chemist for the Cook Paint & Varnish Co., North Kansas City, Mo.

E. E. KIMBLE and A. H. OTIS, president and sales manager, respectively, of the Kimble Glass Co., Vineland, N. J., sailed April 11 on the Aquitania to obtain first-hand information on conditions in the technical glass industry of France, Germany, Italy, Czechoslovakia, Switzerland, England and Scotland.

JOHN C. MILLER, sales manager of the Oklahoma Producing & Refining Corporation, Tulsa, Okla., has resigned. He will be succeeded by D. L. GILLAND, heretofore head of the distributing division of the company.

W. C. PETERSON, metallurgist engineer for the Atlas Crucible Steel Co., resigned April 1, to accept the position of manager of the alloy steel division of the Electric Alloy Steel Co., Youngstown, Ohio. Prior to the position which Mr. Peterson held with the Atlas Crucible Steel Co. he spent 12 years with the Packard Motor Car Co. as supervisor of materials in charge of metallurgical laboratories, heat-treating departments, etc.

C. E. POTTS, who recently resigned as superintendent of the sheet mills of the Inland Steel Co., Indiana Harbor, Ind., owing to ill health, will take up a residence at Los Angeles, Cal.

H. E. RICE, formerly with the R. R. Donnelley & Sons Co., is now in charge of research and development work for the American Printing Ink Co., Chicago, Ill.

R. L. SHEPARD, formerly research engineer for the Solvay

Process Co. of Detroit, is now in charge of the die-casting department of the Shepard Art Metal Co., Detroit, Mich.

Dr. S. E. SHEPPARD, chief of the research laboratory of the Eastman Kodak Co., Rochester, N. Y., recently addressed the local section of the American Chemical Society on "Gelatin in the Photographic Process."

JOHN TOMEK, president of the Thac Industrial Products Corporation, Trenton, N. J., left recently for an extended trip to England, France, Germany and Austria.

PERCY WEDLAKE, formerly with the Washington Steel & Ordnance Co., Washington, D. C., is now with the Wilson-Maeulen Co., New York.

E. J. WINTER, formerly chief engineer of the American Cyanamid Co. and more recently the consulting engineer of the United States Food Products Corporation, of Peoria, Ill., is now associated with Bonn & Co., of New York.

Obituary

Dr. ANDREW MCWILLIAM, a well-known metallurgist and formerly professor of metallurgy in Sheffield University, died at Sheffield on April 5. He had had 24 years' association with the city when, in 1911, he accepted the appointment of head metallurgical adviser to the Government of India. Before his departure for India he was given the degree of doctor of metallurgy for his researches into the metallurgy of steel. For many years he was a most familiar figure at the Iron and Steel Institute meetings, and his numerous papers were always of a practical and suggestive character, and most welcome contributions. He was born in 1867 and educated at Glasgow and the Royal School of Mines, London, where he obtained a first-class scholarship. At one time he was chemist to the Martino Steel Co., and then for 2 years lecturer in metallurgy to the Staffordshire County Council. His principal writings are a book on "General Foundry Practice" and technical papers on "Elimination of Silicon in Acid Open Hearth," "Heat-Treatment of Bessemer Steels" and several on the properties of heat-treated alloy steels.

Prof. EMIL HEYN died at his home in Berlin-Dahlem, March 1. He was born at Annaberg, Erzgebirge, Saxony, in 1867, and was educated at Freiberg. After his college days he spent some time with the Krupp works in Essen, and with the Hoerder Verein (now the Phoenix Co.) of Hoerde, Westphalia. Later he became a member of the faculty of the Royal Machine Construction and Foundry School in Gleiwitz, Silesia, and in 1898 he was called to the Royal Institute for Testing Materials at Lichterfelde, acting as assistant director from 1904 to 1914. Since 1901 he had been professor of mechanical engineering, foundry practice and strength of materials at Charlottenburg Technical Hochschule. He had been president of the German Metallurgical Society since 1918, and in 1921 also assumed the position of director of the Kaiser Wilhelm Institute for Metallurgical Research at Neubabelsberg, near Berlin. Prof. Heyn's published studies have naturally followed the lines of strength of metallic materials as affected by their composition and structure. He was early attracted by the possibilities of metallography, and much of his work was done along these lines. He developed an etching reagent for macroscopic examination of steel; he upheld the idea that there were two iron:carbon equilibrium diagrams, stable and metastable; he called attention to the peculiar physical properties of steel midway between troostite and sorbite, and proposed the name Osmondite for this structure; and he was a stout opponent of the amorphous metal hypothesis. In the non-ferrous field his work was no less important, resulting in many papers on copper and aluminum alloy systems and bearing metals. He also gave much attention to the problem of corrosion. A short elementary book on metallography is from his pen; he also edited the monumental Marten's Handbook of Materials. For several years, however, almost his entire attention had been devoted to the direction of the institutions of which he was the head.

Market Conditions

IN CHEMICAL, METALLURGICAL AND ALLIED INDUSTRIES

A Survey of the Economic and Commercial Factors That Influence Trade in Chemicals and Related Commodities—Prevailing Prices and Market Letters From Principal Industrial Centers

The Rise in Wholesale Prices

Wholesale prices since the beginning of 1922 have shown a steady and appreciable increase. The index numbers of the Bureau of Labor Statistics, recently announced for the month of March, indicate a net rise of 1 point, or approximately two-thirds of 1 per cent, since Feb. 28. Of the 327 commodities, or price series, for which data were obtained, increases were found to have occurred for 104 commodities and decreases for 83 commodities. In the case of 140 no change in the average prices was reported.

The index numbers of wholesale prices by groups of commodities have been as follows during the last 4 months:

INDEX NUMBERS OF WHOLESALE PRICES, BY GROUPS OF COMMODITIES
(1913=100)

	1921 December	1922 January	1922 February	1922 March
Farm products.....	113	116	126	128
Foodstuffs.....	139	134	138	138
Cloths and clothing.....	185	183	183	182
Fuel and lighting.....	187	183	183	183
Metals and metal products.....	119	117	115	114
Building materials.....	203	202	202	202
Chemicals and drugs.....	161	159	159	159
Housefurnishing goods.....	218	214	213	213
Miscellaneous.....	148	146	150	153
All commodities.....	149	148	151	152

Farm products again showed an increase, due to advances in grain, hay, cattle, hogs, sheep and poultry. The increase in this group over the February level was approximately 1½ per cent. Food, fuel, building materials, chemicals and housefurnishing goods showed no change in the general price level. In the two groups of cloths and clothing and metals and metal products prices in March averaged somewhat lower than in February. On the other hand, the group of miscellaneous commodities, including, among others, such important articles as cottonseed meal and oil, linseed meal, slaughterhouse tankage, and a number of vegetable oils largely used for industrial purposes showed an increase of 2 per cent.

Specifications for Petroleum Products

The interdepartmental petroleum specifications committee has adopted a set of specifications for the use of the various government departments and independent establishments. These specifications, corrected to March 1, 1922, are now available as Technical Paper 305 of the Bureau of Mines. This publication supersedes the earlier publications of the committee, which has worked on the subject during the war period and since that time. Specifications are given for

gasoline, naphthas, illuminating oils, fuel oils, lubricants, greases and a wide variety of similar petroleum products. The methods for testing which are to be observed under these specifications will be available shortly as Technical Paper 298 of the bureau. This latter paper, is, however, not yet printed.

The Effect of Tariff Protection on British Chemical Prices

In order to demonstrate any possible effect on British chemical prices of the so-called safeguarding of industries act, the *Times Trade Supplement* of London has taken a dozen chemicals which are entirely or chiefly manufactured in Great Britain and compared them with a similar number which are solely or largely imported.

These compilations, in shillings and pence, and the author's conclusions were as follows:

Chemicals (British)	Value Oct. 1, 1921	Value April 1, 1922
Acetone.....	85/0 cwt.	75/0 cwt.
Aspirin.....	3/2 lb.	2/10 lb.
Benzic acid.....	2/5 lb.	1/6 lb.
Beta naphthol.....	3/6 lb.	2/6 lb.
Calcium lactate.....	2/6 lb.	2/0 lb.
Formaldehyde.....	95/0 cwt.	74/0 cwt.
Formic acid.....	65/0 cwt.	60/0 cwt.
Methyl salicylate.....	2/9 lb.	2/4 lb.
Salicylic acid.....	1/6 lb.	1/4 lb.
Sodium hyposulphite.....	25/0 cwt.	19/6 cwt.
Salol.....	2/8 lb.	2/0 lb.

Chemicals (imported)	Value Oct. 1, 1921	Value April 1, 1922
Amidopyrin.....	21/0 lb.	18/0 lb.
Barbitone.....	12/0 lb.	11/0 lb.
Chloral hydrate.....	5/6 lb.	5/0 lb.
Guaiacol carbonate.....	12/6 lb.	9/6 lb.
Hexamethylenetetramine.....	4/3 lb.	3/0 lb.
Lithium carbonate.....	12/0 lb.	10/6 lb.
Paraldehyde.....	2/0 lb.	1/4 lb.
Phenacetine.....	6/6 lb.	5/3 lb.
Phenazone.....	8/0 lb.	7/6 lb.
Phenolphthalein.....	4/6 lb.	3/3 lb.
Potassium permanganate.....	1/9 lb.	— 9 lb.
Resorcin.....	8/3 lb.	7/3 lb.

"In order to arrive at a definite ratio of values it is convenient to consider each item as a unit and total the four columns. Thus treated, the British chemicals show values of £14 10s. 10d. (in October) and £12 5s. (in April), and the imported chemicals £4 17s. 6d. (in October) and £4 2s. 4d. (in April). By coincidence the percentage of difference is almost identical, and the average decrease in value of all the chemicals included is over 15 per cent. In other words, the act has not led to a general increase in price to the consumer of either British or foreign chemicals, despite the 33½ per cent duty and the prophecies to the contrary."

German Dye Prices and Dividends

According to a recent dispatch from Frankfort-on-the-Main to the *New York Journal of Commerce*, German manufacturers have announced a general increase in the prices of their products. The new quotations are said to be 40 to 50 per cent higher than the price schedule which is now superseded.

A later radio dispatch from the same source reports that the great dye combine (Interessen Gemeinschaft) earned a dividend of 30 per cent on its capital stock during the fiscal year 1921, as compared with 20 per cent in the preceding year.

CHEMICAL & METALLURGICAL ENGINEERING'S WEIGHTED INDEX OF CHEMICAL PRICES

Base = 100 for the year July 1, 1913, to June 30, 1914

This week	158.27
Last week	158.81
April, 1917	207
April, 1918 (high)	286
April, 1920	261
April, 1921 (low)	140

Practically no change was noted in the index number during the past week. Of the six commodities for which price changes were noted, four—viz., caustic soda, caustic potash, barium chloride and linseed oil—showed slightly higher prices and two—viz., crude potassium carbonate and cottonseed oil—showed decreases. The importance of the weighting for cottonseed oil was sufficient to more than compensate for the small increases in the other commodities.

Allied Chemical & Dye Corporation Reports Better Business Conditions

Although there was a marked fall in the earnings of the Allied Chemical & Dye Corporation in 1921, the recent annual report indicates that the corporation is in a stronger financial position and since the beginning of 1922 has enjoyed a much improved demand for its products.

The reduction in business due to the general depression is shown by the considerably lower income. After charges, inventory adjustments, federal taxes and preferred dividends, the net income was \$7,646,909, equivalent to \$2.27 a share on the outstanding common stock. In 1920 the income was \$16,179,939, or \$6.33 a share. Inventory adjustments in 1921 were \$3,940,557, as compared with \$10,226,688 for the previous year. However, the inventory on Dec. 31, 1921, stood at \$33,434,653 and on the corresponding date in 1920 was \$45,602,875.

Dr. W. H. Nichols, chairman of the board, pointed out in his letter to stockholders that the most important technical development in 1921 was the successful production on a commercial scale of synthetic ammonia at the nitrogen-fixation plant, Syracuse, N. Y. This plant, the only one of its kind in the United States, has been running at full capacity since it was completed last fall.

U. S. Industrial Alcohol Reports Deficit

The U. S. Industrial Alcohol Co., for the first time in its history, showed a net loss in 1921. This amounted to \$572,047, after charges, depreciation and inventory adjustment. During the previous year the company had a net income of \$3,339,499 and paid a dividend of \$11.63 on its common stock.

The record of the company's earnings and dividends for the past 11 years is given in the following table:

Year Ended Dec. 31	Operating Income	Net Income	Amount Earned on Common Stock
1911	\$1,308,399	\$ 902,745	\$2.01
1912	1,437,522	1,021,751	2.51
1913	1,006,774	652,358	0.97
1914	1,069,602	653,264	0.97
1915	2,724,607	2,172,013	7.30
1916	6,727,043	4,756,025	18.06
1917	12,511,277	6,980,420	27.33
1918	14,073,102	6,621,309	25.83
1919	4,426,265	2,834,858	10.06
1920	5,102,831	3,339,499	11.63
1921	82,638*	572,047*	.....

*Loss.

The New York Market

NEW YORK, April 24, 1922.

Leading producers report a steady call for the more important commodities, and shipment prices have maintained their former strength throughout the week. The most important feature of the market was the continued rise of barium chloride and yellow prussiate of potash. Inquiries from Italy and other European countries for solid caustic soda are keeping the export market for that commodity in a very firm position and the present tendency of alkali prices is upward. The recent rise in citric acid has been firmly maintained. Cyanide of soda has been somewhat neglected and prices showed a slight decline both for foreign and domestic material. Cream of tartar has displayed a stronger tone and the market recorded an advance for the week. The general list of products so far this month has shown every tendency to remain firm and leading factors have interpreted this as an approach to better business conditions.

GENERAL CHEMICALS

Acetic Acid.—There has been a better demand since the first of the month for this material. Producers offer the 28 per cent at \$2.35 per 100 lb. in barrels. Large orders could probably be purchased down to \$2.25. The 56 per cent has sold at 5c. per lb., and the glacial 99½ per cent sold at 9c. per lb.

Barium Chloride.—This material continued exceptionally strong throughout the entire week and quotations were around \$100 per ton for spot goods in very limited quantities.

This product has recorded a 100 per cent advance within the past few months. May-June shipment was held at \$90 per ton. All other barium products have shown additional strength in sympathy with the chloride.

Bleaching Powder.—Domestic bleach is moving quietly at \$1.60 per 100 lb. in large drums, f.o.b. works. The imported is quoted at \$1.70 per 100 lb. dock. The demand is rather slow, with real competition for any passing business.

Borax.—Contracts for large quantities are held at 5½c. per lb. in bags, 5½@5½c. in barrels and 6c. per lb. in kegs. Small lots on the spot market command higher prices.

Boric Acid.—Round lots in bags are moving at 11c. per lb. and at 11½c. in barrels. Kegs are held around 12c. per lb. Small lots command a premium of ¼@½c. per lb. above these prices.

Caustic Potash.—Large importers report a moderate demand for the 88-92 per cent and reported several transactions at 5½@6c. per lb. Shipment material is not attracting very much attention, as prices are in most cases above spot material.

Caustic Soda.—Export inquiries continue to reach the market and additional sales to Italy were recorded at \$3.65 @ \$3.70 per 100 lb. Dealers are holding resale lots at \$3.75 per 100 lb.

Cyanide of Soda.—Imported and domestic goods are a shade easier under a somewhat neglected buying condition. Sellers of imported offer spot goods at 22@24c. per lb., depending on strength. Domestic material is held at 25c. per lb.

Nitrite of Soda.—The market appears rather firm and several transactions were recorded at 8½@9c. per lb. The general range is 8½@9½c. per lb., depending upon seller and quantity. Consumers are not buying any more than actual wants.

Prussiate of Potash.—There has been a pronounced scarcity in the yellow material. Spot offerings were exceedingly limited and dealers were asking 28c. per lb. The red variety still continues very scarce, with sellers asking 75c. per lb. for shipment.

COAL-TAR PRODUCTS

The only outstanding feature in this market during the past week was the strength displayed by phenol. Resale lots are very scarce and firmly maintained. Benzene still continues in a very strong condition and little is obtainable on spot because of the steady absorption of deliveries on contracts to consumers. The recent reduction in the price of phthalic anhydride is bringing out a better demand and business has shown a noticeable improvement. Cresylic acid is firm at the recent advance.

Aniline Oil.—First hands were quoting 16c. per lb. and reported sales consummated at this figure. The demand has not been any too brisk and it was intimated that shading could be done on firm business.

Beta Naphthol.—There has been a better inquiry noted for this product and producers stated that they were getting 26@27c. per lb., depending on quantity. The sublimed is unchanged at 60c. per lb.

Acid.—Some small lot orders have been recorded among first hands. The lowest price heard was 85c. per lb., with the range up to \$1, depending upon quantity. Demand is not very encouraging.

Phenol.—There has been no departure from the firm position of this crude. Second hands stated that it is doubtful if better than 12½c. per lb. could be done, while 13c. was being asked in several directions. Leading producers quoted the prime white crystals, U.S.P., at 15@17c. per lb.

Sulphanilic Acid.—Leading sellers are holding the market at 24@26c. per lb., but might shade these figures on firm business, owing to the slow movement. Sales are only of a light routine nature.

Naphthalene.—There were still a few consuming inquiries recorded during the week, but the general movement is rather quiet and large sellers are very much disappointed with the results of the season. Leading producers are unchanged in their recent prices.

The Chicago Market

CHICAGO, Ill., April 20, 1922.

Little change was to be noted in the general chemical market during the past week. Business continued fairly active and factors reported a satisfactory volume of small or medium-sized orders. Large buyers are still apparently holding off and are taking supplies for immediate consumption only. Practically all prices were firm and first hands were in control of the market, which is generally regarded as a healthy sign. Imported chemicals continue to advance in price and are becoming scarce.

GENERAL CHEMICALS

The alkali market was firm and stocks were reported to be moving fairly well in small lots. Solid *caustic soda* was quoted at \$3.75@4 per 100 lb. and the ground at \$4.35@4.50. *Caustic potash* is very firm and most sellers have advanced their price on the 88-92 per cent material to 7c., although it was reported that a few small lots could be had at 6½c. *Soda ash* continued to move in the regular channels at \$2.30 per 100 lb. for small lots in cooperage.

Alums were apparently in a firm position, but no transactions of consequence were reported. *Ammonia alum* was quiet at 4½@5c. per lb. for the ground. *Potash alum* was in some demand and the lumps could be bought at 5½c. for the U.S.P. or 4½c. for the technical. *Powdered potash alum* was in fair demand from the photographic trade and supplies were available at 5½@6½c., according to the quantity and the seller. Barium compounds were in an exceptionally firm position and prices showed a considerable advance. *Barium chloride* was very difficult to locate and the best offer noted was for shipment from the East at \$90 per ton. *Copper sulphate* was in active demand and prices were firm at 6@6½c. per lb. With warm weather in sight there was some pressure to sell *bleach*, which could be had at 2½@3c. per lb. *White arsenic* is a little easier and supplies could be had at around 7½c. per lb. *Furfural* is still available at 50c. per lb. in single-drum lots. *Carbon tetrachloride* moved in a routine way and was unchanged at 10½@11c. per lb. Nothing new developed in the *glycerine* market and refiners continued to offer c.p. material at 16½c. per lb. bulk basis.

Potash bichromate was quiet and unchanged at 11½@13c. per lb. *Soda bichromate* was in a similar position and was available at 9@9½c. per lb. A small sale of *red prussiate of potash* at 90c. per lb. was reported early in the week. *Yellow prussiate of potash* continued to move well at 32@35c. per lb. *Hypo* was in a somewhat better demand and was unchanged at \$3.95 per 100 lb. for the pea crystals in barrels.

LINSEED OIL—NAVAL STORES

Prominent factors in *linseed oil* reported a good movement in consuming channels. Prices were a little higher, with today's market on the boiled oil in 5-drum lots at 88c. per gal. and similar quantities of the raw at 86c.

Turpentine, like *linseed oil*, was reported to be moving in a satisfactory volume to the paint trade. Today's market on 5-drum lots was 83c. per gal., which represented a small decline. *Rosin* was in fair demand, and the "G" grade in less than carlots could be had at \$6.35 per 280 lb.

The Iron and Steel Market

PITTSBURGH, April 21, 1922.

Strikes in the Connellsville and Lower Connellsville region have spread somewhat farther in the past week, but the tide appears now to have become stationary. Production of coal in the region as a whole is probably at not over one-third the rate in March, shipments of coal being decreased in greater ratio and production of coke in the region in somewhat less ratio. Of the strikes produced in non-union coal fields by the United Mine Workers, those in the Connellsville region are by far the most important. In many districts, according to the latest report of the Geological Survey, the demand for coal is insufficient to give the mines as full employment as labor conditions would admit.

By various means the iron and steel producers have tempered the effects of the Connellsville strikes, so that

production is not restricted in full proportion to the amount of striking. There has been some additional drawing upon coal districts in position to produce freely, while there is some drawing upon stocks of coal.

Even to this date the influence of the Connellsville strikes has been more marked in preventing resumption of mills and furnaces than in restricting operations that were in progress April 1, whereby the production of steel is probably at a somewhat greater rate this week than on the last day of March, when steel ingot production was proceeding at the rate of 35,000,000 or 36,000,000 tons a year, against a rate of about 30,000,000 tons March 1 and an average rate of slightly under 20,000,000 tons in December.

CHANGED CHARACTER OF BUYING

The whole steel market is largely under the influence of the coal strike, in a double manner. Conservative and far-sighted buyers purchased liberally in February and March and undoubtedly accumulated stocks. Such buyers are not so conspicuous in the market now, while another class of buying has developed, on the part of consumers and distributors who appear decidedly frightened. The producers do not look with much favor upon buying of this sort, having some doubt whether the material will be entirely acceptable to the inquirers when delivered. The mills have learned to distinguish between the buyer who is attracted by a low price and the buyer who is attracted by an advanced price.

Inasmuch as the coal strike was expected for a year or so and serious efforts were made to insure against its possible effects, a quite erroneous view of the situation would be obtained by assuming that the strike, now that it has begun, has produced really important consequences. It is quite possible that serious consequences in markets generally would have followed had the strike suddenly been called off March 31. The steel situation appears stronger by reason of the strike, but perhaps it had need of some stiffening influence at this time.

Finished steel prices are being quite firmly maintained. This situation may be due to the coal strike, as is assumed in many quarters, or it may be due to mills having had fairly large sales and being disposed to stand their ground simply because they are fortified by back-log business. If so, the phenomenon is a familiar one.

Bars, shapes and plates are quite rigidly maintained at 1.50c., concessions from this figure being unusual if not entirely absent. Regular list prices on tubular goods are very well maintained, concessions having been dwindling for about 6 weeks past. Tin plate is reported quite firm at the official or regular price of \$4.75. Sheets are held at prices as recently advanced \$3 a ton. Hoops and bands are up \$2 a ton, to 2c. In nails the independents maintain their recent advance to \$2.50, while the Steel Corporation's price remains \$2.40.

PIG IRON HIGHER

While the merchant furnaces may not have been definitely withdrawing as sellers, they have presented much the appearance of doing so, and quotable prices have advanced by an average of fully \$2 a ton in the past fortnight. The valley market now stands at \$21 for *bessemer*, \$20 for *basic* and \$21 for *foundry*, these being minimum prices, with some doubt as to whether any large purchases could be made at these figures. In *bessemer* the advance over the price April 1 is \$1.50, while *basic* and *foundry* are up \$2. Prices may work up still farther, as they are even now hardly up to what merchant furnaces assert is their cost. If Lake Superior ore prices for the 1922 season are developed in the near future, they will doubtless be in relation to these new prices for pig iron, in which case there would not be the reduction of about \$1 a ton from the 1921 schedule that was being predicted 3 months and more ago.

Connellsville coke is not quotable as presenting regular market prices. The furnaces state they could not afford to pay advanced prices, while the offerings are only of extremely small lots, not enough to be worth while to a blast furnace, even if the price were satisfactory. In *foundry coke* the demand is largely withdrawn, foundries generally having stocked in the past couple of months.

General Chemicals

CURRENT WHOLESALE PRICES IN NEW YORK MARKET

	Carlots	Less Carlots		Carlots	Less Carlots
Acetic anhydride.....lb.			Potassium bichromate.....lb.	104-104	104-104
Acetone.....lb.	\$0.09 - \$0.09	\$0.38 - \$0.40	Potassium bromide, granular.....lb.	12-12	17-23
Acid, acetic, 28 per cent.....100 lbs.	2.35 - 2.50	2.55 - 3.00	Potassium carbonate, U. S. P.....lb.	04-05	13-16
Acetic, 56 per cent.....100 lbs.	5.00 - 5.25	5.30 - 5.50	Potassium carbonate, 80-85%.....lb.	06-06	05-06
Acetic, glacial, 99 1/2 per cent, carboys.....100 lbs.	9.00 - 9.50	9.75 - 10.00	Potassium chlorate, crystals.....lb.	07-07	06-08
Boric, crystals.....lb.	11-11	11-12	Potassium cyanide.....lb.	5.90 - 6.00	6.10 - 7.00
Boric, powder.....lb.	11-11	11-12	Potassium iodide.....lb.	07-07	08-09
Citric.....lb.	11-11	11-12	Potassium nitrate.....lb.	15-15	16-22
Hydrochloric.....100 lb.	1.10 - 1.20	1.25 - 1.70	Potassium permanganate.....lb.	nominal	nominal
Hydrofluoric, 52 per cent.....lb.	09-10	10-12	Potassium prussiate, red.....lb.	28-28	28-29
Lactic, 44 per cent tech.....lb.	04-04	04-05	Potassium prussiate, yellow.....lb.	07-07	07-08
Molybdic, e.p.....lb.	3.00 - 3.25	3.30 - 3.75	Rochelle salts (see sodium potas. tartrate).....lb.	07-07	08-08
Muriatic, 20 deg. (see hydrochloric).....lb.	06-06	06-07	Salammoniac, white, granular.....lb.	07-07	08-08
Nitric, 40 deg.....lb.	06-06	06-07	Salammoniac, gray, granular.....lb.	1.45 - 1.55	1.60 - 1.85
Nitric, 42 deg.....lb.	06-06	06-07	Salsoda.....100 lb.	18.00 - 20.00	2.05 - 2.60
Oxalic, crystals.....lb.	11-12	12-13	Salt cake (bulk).....ton	1.80 - 2.00	2.00 - 2.50
Phosphoric, 50 per cent solution.....lb.	08-08	08-09	Soda ash, light.....100 lb.	1.85 - 1.95	0.41-0.5
Picric.....lb.	22-24	24-30	Soda ash, dense.....100 lb.	04-04	0.41-0.5
Pyrogallol, resublimed.....lb.	1.65 - 1.75	1.75 - 2.00	Sodium acetate.....lb.	1.80 - 1.90	1.95 - 2.40
Sulphuric, 60 deg., tank cars.....ton	11.00 - 12.00	21.00 - 22.00	Sodium bicarbonate.....lb.	07-07	08-08
Sulphuric, 60 deg., drums.....ton	12.00 - 14.00		Sodium bichromate.....lb.	4.50 - 4.60	4.65 - 5.50
Sulphuric, 66 deg., tank cars.....ton	17.00 - 17.50		Sodium bisulphate (nitre cake).....ton	04-04	04-05
Sulphuric, 66 deg., drums.....ton	20.00 - 20.50		Sodium bisulphate powdered, U.S.P.....lb.	06-07	07-07
Sulphuric, 66 deg., carboys.....ton			Sodium chlorate.....long ton	12.00 - 13.00	
Sulphuric, fuming, 20 per cent (oleum).....ton	19.50 - 20.00		Sodium cyanide.....lb.	22-23	23-25
Sulphuric, fuming, 20 per cent (oleum).....ton	22.00 - 22.50	23.00 - 24.00	Sodium fluoride.....lb.	09-10	10-10
Sulphuric, fuming, 20 per cent (oleum).....ton	31.00 - 32.00	33.00 - 34.00	Sodium hydroxide (caustic soda).....100 lb.	3.70 - 3.75	3.80 - 4.25
Tannic, U. S. P.....lb.	40-45	46-50	Sodium hypsulphite.....lb.	03-03	03-03
Tartaric, imported crystals.....lb.		26-28	Sodium nitrite.....lb.	08-09	09-09
Tartaric acid, imported, powdered.....lb.		27-30	Sodium peroxide, powdered.....lb.	28-30	31-35
Tartaric acid, domestic.....lb.		1.00 - 1.10	Sodium phosphate, dibasic.....lb.	03-04	04-04
Tungstic, per lb. of W.O.....gal.		4.75 - 5.50	Sodium potassium tartrate (Rochelle salts).....lb.	16-16	17-17
Alcohol, ethyl.....gal.		32-34	Sodium prussiate, yellow.....lb.	85-100	1.05 - 1.15
Alcohol, methyl (see methanol).....gal.		32-34	Sodium silicate, solution (40 deg.).....100 lb.	2.35 - 2.50	2.55 - 2.90
Alcohol, denatured, 188 proof No. 1.....gal.		32-34	Sodium silicate, solution (60 deg.).....100 lb.	85-100	1.10 - 1.50
Alcohol, denatured, 188 proof No. 5.....gal.		32-34	Sodium sulphate, crystals (glaubers salt) 100 lbs.	04-04	04-05
Alum, ammonia, lump.....lb.	03-03	04-04	Sodium sulphide, fused, 60-62 per cent (conc.) lb.	03-03	03-04
Alum, potash, lump.....lb.	03-04	04-05	Sodium sulphite, crystals.....lb.	09-10	10-12
Alum, chrome, lump.....lb.	07-08	08-09	Sulphur, chloride, yellow.....lb.	04-05	05-06
Aluminum sulphate, commercial.....100 lb.	1.50 - 1.65	1.70 - 2.25	Sulphur, crude.....ton	18.00 - 20.00	
Aluminum sulphate, iron free.....lb.	02-02	03-03	Sulphur dioxide, liquid, cylinders extra.....lb.	08-08	09-10
Aqua ammonia, 26 deg. drums (750 lb.) lb.	07-07	08-08	Sulphur (sublimed), flour.....100 lb.		2.25 - 3.10
Ammonia, anhydrous, cyl. (100-150 lb.) lb.	30-30	31-33	Sulphur, roll (brimstone).....100 lb.		2.00 - 2.75
Ammonium carbonate, powder.....lb.	07-07	08-09	Talc—imported.....ton	30.00 - 40.00	
Ammonium nitrate.....lb.	06-06	06-07	Talc—domestic powdered.....ton	18.00 - 25.00	
Amylacetate tech.....gal.		2.00 - 2.25	Tin bichloride.....lb.	09-09	09-10
Arsenic, white, powdered.....lb.	07-07	07-08	Tin oxide.....lb.		37-38
Arsenic, red, powdered.....lb.	12-12	12-13	Zinc carbonate.....lb.	14-14	14-15
Barium chloride.....ton	100.00 - 105.00	105.00 - 110.00	Zinc chloride, gran.....lb.	05-06	06-06
Barium dioxide (peroxide).....lb.	20-21	21-22	Zinc cyanide.....lb.	42-44	45-47
Barium nitrate.....lb.	06-07	07-08	Zinc oxide, XX.....lb.	07-08	08-08
Barium sulphate (precip.) (blanc fixe) lb.	03-04	04-04	Zinc sulphate.....100 lb.	2.75 - 3.00	3.05 - 3.30
Blanc fixe, dry.....lb.	04-04				
Blanc fixe, pulp.....ton	45.00 - 55.00				
Bleaching powder.....100 lb.	1.60 - 1.75	1.80 - 2.75			
Blue vitriol (see copper sulphate).....lb.	05-05	06-06			
Borax.....lb.	05-05	06-06			
Brimstone (see sulphur, roll).....lb.	27-28	28-35			
Bromine.....100 lbs.	1.75 - 2.00				
Calcium acetate.....100 lbs.	04-04	05-05			
Calcium carbide.....lb.	24.00 - 24.50	24.75 - 27.00			
Calcium chloride, fused, lump.....ton	01-01	02-02			
Calcium chloride, granulated.....lb.		1.40 - 1.50			
Calcium peroxide.....lb.		15-16			
Calcium phosphate, tribasic.....lb.		80-82			
Camphor.....lb.	06-06	06-07			
Carbon bisulphide.....lb.	09-10	10-12			
Carbon tetrachloride, drums.....lb.		60-75			
Carbonyl chloride (phosgene).....lb.					
Caustic potash (see potassium hydroxide).....lb.					
Caustic soda (see sodium hydroxide).....lb.	04-04				
Chalk, precip.—domestic, light.....lb.	05-05				
Chalk, precip.—domestic, heavy.....lb.	04-05				
Chalk, precip.—imported, light.....lb.	05-05	05-06			
Chlorine, gas, liquid—cylinders (100 lb.) lb.		37-40			
Chloroform.....lb.		2.00 - 2.10			
Cobalt oxide.....ton	15.00 - 16.00	16.50 - 30.00			
Copperas.....ton	19-20	20-21			
Copper carbonate, green precipitate.....lb.		58-60			
Copper cyanide.....100 lb.	5.50 - 5.60	5.65 - 6.15			
Copper sulphate, crystals.....100 lb.		24-26			
Cream of tartar.....lb.		60-65			
Epsom salt (see magnesium sulphate).....gal.		93-100			
Ethyl acetate com. 85%.....gal.		09-10			
Ethyl acetate, pure (acetic ether, 98% to 100%).....gal.					
Formaldehyde, 40 per cent.....lb.	16.00 - 17.00				
Fullers earth, f.o.b. mines.....net ton	30.00 - 32.00	2.15 - 2.50			
Fullers earth—imported powdered—net ton		1.25 - 1.50			
Fusel oil, ref.....gal.					
Fusel oil, crude.....gal.					
Glauber's salt (see sodium sulphate).....lb.		15-15			
Glycerine, e. p. drums extra.....lb.		4.05 - 4.15			
Iodine, resublimed.....lb.		12-18			
Iron oxide, red.....lb.		14-15			
Lead acetate.....lb.	14-14	15-20			
Lead arsenate, powd.....lb.		08-08			
Lead nitrate.....lb.	07-07	08-08			
Litharge.....lb.	06-06	06-08			
Magnesium carbonate, technical.....100 lb.	2.50 - 2.60	2.65 - 2.85			
Magnesium sulphate, U. S. P.....100 lb.		1.00 - 1.80			
Magnesium sulphate, technical.....100 lb.		57-58			
Methanol, 95%.....gal.		59-60			
Methanol, 97%.....lb.		11-11			
Nickel salt, double.....lb.		11-11			
Nickel salt, single.....lb.		47-50			
Phosgene (see carbonyl chloride).....lb.	43-44	30-35			
Phosphorus, red.....lb.					
Phosphorus, yellow.....lb.					

Coal-Tar Products

NOTE—The following prices are for original packages in large quantities:

Alpha-naphthol, crude.....lb.	\$1.00 - \$1.05
Alpha-naphthol, refined.....lb.	1.10 - 1.15
Alpha-naphthylamine.....lb.	30-31
Aniline oil, drums extra.....lb.	16-16
Aniline salts.....lb.	24-26
Anthracene, 80% n drums (100 lb.).....lb.	75-100
Benzaldehyde U.S.P.....100 lbs.	1.25 - 1.30
Benzidine, base.....lb.	85-90
Benzidine sulphate.....lb.	75-80
Benzoic acid, U.S.P.....lb.	60-65
Benzoate of soda, U.S.P.....lb.	55-57
Benzene, pure, water-white, in drums (100 gal.).....gal.	29-35
Benzene, 90%, in drums (100 gal.).....gal.	27-32
Benzyl chloride, 95-97%, refined.....lb.	25-27
Benzyl chloride, tech.....lb.	20-23
Beta-naphthol benzoate.....lb.	3.75 - 4.00
Beta-naphthol, sublimed.....lb.	60-65
Beta-naphthol, tech.....lb.	26-28
Beta-naphthylamine, sublimed.....lb.	1.50 - 1.60
Cresol, U. S. P., in drums (100 lb.).....lb.	12-15
Ortho-cresol, in drums (100 lb.).....lb.	16-18
Cresylic acid, 97-99%, straw color, in drums.....gal.	53-55
Cresylic acid, 75-97%, dark, in drums.....gal.	48-50
Dichlorobenzene.....lb.	06-09
Diethylaniline.....lb.	80-85
Dimethylaniline.....lb.	38-40
Dinitrobenzene.....lb.	23-25
Dinitrochlorobenzene.....lb.	23-25
Dinitronaphthalene.....lb.	30-32
Dinitrophenol.....lb.	33-35
Dinitrotoluene.....lb.	22-24
Dip oil, 25% car lots, in drums.....gal.	24-26
Diphenylamine.....lb.	59-65
H-acid.....lb.	85-100
Meta-phenylenediamine.....lb.	90-100
Monochlorobenzene.....lb.	14-15
Monoethylaniline.....lb.	1.10 - 1.25
Naphthalene crushed, in bbls.....lb.	06-06
Naphthalene, flake.....lb.	06-07
Naphthalene, balls.....lb.	08-08
Naphthionic acid, crude.....lb.	65-70
Nitrobenzene.....lb.	10-12
Nitro-naphthalene.....lb.	30-35
Nitro-toluene.....lb.	15-17
Ortho-amidophenol.....lb.	2.60 - 2.75
Ortho-dichlorobenzene.....lb.	15-20
Ortho-nitro-phenol.....lb.	70-75
Ortho-nitro-toluene.....lb.	12-15
Ortho-toluidine.....lb.	16-20
Para-amidophenol, base.....lb.	1.25 - 1.30
Para-amidophenol, HCl.....lb.	1.30 - 1.35
Para-dichlorobenzene.....lb.	15-18
Paranitroaniline.....lb.	75-77
Para-nitrotoluene.....lb.	65-70
Para-phenylenediamine.....lb.	1.50 - 1.55
Para-toluidine.....lb.	1.05 - 1.15
Phthalic anhydride.....lb.	36-38

Phenol, U. S. P., drums.....	lb.	1.21	—	15
Pyridine.....	gal.	1.75	—	2.75
Resorcinol, technical.....	lb.	1.30	—	1.35
Resorcinol, pure.....	lb.	1.75	—	1.80
Salicylic acid, tech., in bbls.....	lb.	24	—	24
Salicylic acid, U. S. P.....	lb.	25	—	26
Solvent naphtha, water-white, in drums, 100 gal.....	gal.	25	—	28
Solvent naphtha, crude, heavy, in drums, 100 gal.....	gal.	10	—	12
Sulphanilic acid, crude.....	lb.	24	—	26
Tolidine.....	lb.	1.20	—	1.30
Toluidine, mixed.....	lb.	30	—	35
Toluene, in tank cars.....	gal.	25	—	28
Toluene, in drums.....	gal.	30	—	35
Xylidines, drums, 100 gal.....	lb.	40	—	45
Xylene, pure, in drums.....	gal.	40	—	45
Xylene, pure, in tank cars.....	gal.	45	—	50
Xylene, commercial, in drums, 100 gal.....	gal.	33	—	35
Xylene, commercial, in tank cars.....	gal.	30	—	35

Waxes

Prices same as previous report.

Naval Stores

All prices are f.o.b. New York unless otherwise stated, and are based on carload lots. The oils in 50-gal. bbls., gross weight, 500 lb.

Rosin B-D, bbl.....	280 lb.	\$5.25	—	5.30
Rosin E-I.....	280 lb.	5.35	—	5.40
Rosin K-N.....	280 lb.	5.45	—	5.55
Rosin W. G.-W. W.....	280 lb.	7.00	—	7.25
Wood rosin, bbl.....	280 lb.	6.25	—	6.30
Spirits of turpentine.....	gal.	.85	—	.85
Wood turpentine, steam dist.....	gal.	.85	—	.85
Wood turpentine, dest. dist.....	gal.	.70	—	.70
Pine tar pitch, bbl.....	200 lb.	6.00	—	6.00
Tar, kilo burned, bbl. (500 lb.).....	bbl.	9.50	—	9.50
Retort tar, bbl.....	500 lb.	9.00	—	9.00
Rosin oil, first run.....	gal.	.36	—	.36
Rosin oil, second run.....	gal.	.38	—	.38
Rosin oil, third run.....	gal.	.46	—	.46
Pine oil, steam dist., sp.gr. 0.930-0.940.....	gal.	1.90	—	1.90
Pine oil, pure, dest. dist.....	gal.	1.50	—	1.50
Pine tar oil, ref., sp.gr. 1.025-1.035.....	gal.	.46	—	.46
Pine tar oil, crude, sp.gr. 1.025-1.035 tank cars f.o.b. Jacksonville, Fla.....	gal.	.35	—	.35
Pine tar oil, double ref., sp.gr. 0.965-0.990.....	gal.	.35	—	.35
Pine tar, ref., thin, sp.gr. 1.080-1.060.....	gal.	.35	—	.35
Turpentine, crude, sp.gr. 0.900-0.970.....	gal.	1.25	—	1.25
Hardwood oil, f.o.b. Mich., sp.gr. 0.960-0.990.....	gal.	.35	—	.35
Pinewood creosote, ref.....	gal.	.52	—	.52

Fertilizers

Quotations remain unchanged.

Crude Rubber

All prices same as report of April 19.

Oils

VEGETABLE

The following prices are f.o.b. New York for carload lots.

Castor oil, No. 3, in bbls.....	lb.	\$0.10	—	\$0.10
Castor oil, AA, in bbls.....	lb.	.11	—	.12
China wood oil, in bbls.....	lb.	.13	—	.13
Coconut oil, Ceylon grade, in bbls.....	lb.	.08	—	.09
Coconut oil, Cochiti grade, in bbls.....	lb.	.09	—	.09
Corn oil, crude, in bbls.....	lb.	.11	—	.11
Cottonseed oil, crude (f. o. b. mill).....	lb.	.09	—	.10
Cottonseed oil, summer yellow.....	lb.	.12	—	.12
Cottonseed oil, winter yellow.....	lb.	.13	—	.13
Linseed oil, raw, car lots (domestic).....	gal.	.85	—	.86
Linseed oil, raw, tank cars (domestic).....	gal.	.81	—	.82
Linseed oil, in 5-bbl lots (domestic).....	gal.	.88	—	.89
Olive oil, denatured.....	gal.	1.12	—	1.15
Palm, Lagos.....	lb.	.07	—	.08
Palm, Niger.....	lb.	.05	—	.06
Peanut oil, crude, tank cars (f.o.b. mill).....	lb.	.09	—	.10
Peanut oil, refined, in bbls.....	lb.	.12	—	.13
Rapeseed oil, refined in bbls.....	gal.	.83	—	.84
Rapeseed oil, blown, in bbls.....	gal.	.86	—	.87
Soya bean oil (Manchurian), in bbls. N. Y.....	lb.	.10	—	.11
Soya bean oil, tank cars, f.o.b., Pacific coast.....	lb.	.09	—	.10

FISH

Light pressed menhaden.....	gal.	\$0.54	—	.....
Yellow bleached menhaden.....	gal.	.57	—	.....
White bleached menhaden.....	gal.	.56	—	.....
Blown menhaden.....	gal.	.61	—	.....

Miscellaneous Materials

Prices remain quotably unchanged.

Refractories

Quotations remain same as previous report.

Ferro-Alloys

All f.o.b. Works

Ferrocobalt-titanium, 15-18%, f.o.b. Niagara Falls, N. Y.....	net ton	\$200.00	—	\$225.00
Ferrochromium, per lb. of Cr contained, 6-8% carbon, carlots.....	lb.	.11	—	.....
Ferrochromium, per lb. of Cr contained, 4-6% carbon, carlots.....	lb.	.11	—	.....
Ferromanganese, 76-80% Mn, domestic.....	gross ton	67.00	—	69.00
Spiegelisen, 18-22% Mn.....	gross ton	30.00	—	35.00
Ferromolybdenum, 50-60% Mo, per lb. of Mo.....	lb.	2.00	—	2.25
Ferrosilicon, 10-15%.....	gross ton	38.00	—	40.00
Ferrosilicon, 50%.....	gross ton	54.00	—	55.00
Ferrosilicon, 75%.....	gross ton	115.00	—	120.00
Ferrotungsten, 70-80%, per lb. of contained W.....	lb.	.37	—	.50
Ferro-uranium, 35-50% of U, per lb. of U content.....	lb.	6.00	—	.....
Ferrovanadium, 30-40% per lb. of contained V.....	lb.	3.55	—	3.75

Ores and Semi-finished Products

All f.o.b. New York, Unless Otherwise Stated

Bauxite, 52% Al content.....	net ton	\$6.00	—	\$12.00
Chrome ore, Calif. concentrates, 50% min. Cr ₂ O ₃	ton	19.00	—	20.00
Chrome ore, 50% Cr ₂ O ₃ , f.o.b. Atlantic seaboard.....	ton	19.00	—	20.00
Coke, foundry, f.o.b. ovens.....	net ton	4.25	—	4.75
Coke, furnace, f.o.b. ovens.....	net ton	3.50	—	3.75
Fluorspar, gravel, f.o.b. mines, New Mexico.....	net ton	12.00	—	.....
Fluorspar, standard, domestic washed gravel Kentucky and Illinois mines.....	net ton	20.00	—	22.00
Ilmenite, 52% TiO ₂ , per lb. ore.....	lb.	.01	—	.01
Manganese ore, 50% Mn, c.i.f. Atlantic seaport.....	unit	.26	—	.27
Manganese ore, chemical (MnO ₂).....	net ton	60.00	—	65.00
Molybdenite, 85% MoS ₂ , per lb. of MoS ₂ , N. Y.....	lb.	.40	—	.42
Monasite, per unit of ThO ₂ , c.i.f. Atlantic seaport.....	unit	27.00	—	.....
Pyrites, Spanish, fines, c.i.f. Atlantic seaport.....	unit	.12	—	.12
Pyrites, Spanish, furnace size, c.i.f. Atlantic seaport.....	unit	.13	—	.13
Pyrites, domestic, fines, f.o.b. mines, Ga.....	unit	.11	—	.12
Rutile, 95% TiO ₂ per lb. ore.....	lb.	.12	—	.....
Tungsten, scheelite, 60% WO ₃ and over, per unit of WO ₃ (nominal).....	unit	2.25	—	2.50
Tungsten, wolframite, 60% WO ₃ and over, per unit of WO ₃ , N. Y. C.....	unit	2.50	—	2.75
Uranium ore (carnotite) per lb. of U ₃ O ₈	lb.	1.25	—	1.75
Uranium oxide, 96% per lb. contained U ₃ O ₈	lb.	2.25	—	2.50
Vanadium pentoxide, 99%.....	lb.	12.00	—	14.00
Vanadium ore, per lb. of V ₂ O ₅ contained.....	lb.	1.00	—	.....
Zircon, washed, iron free, f.o.b. Pablo, Florida.....	lb.	.04	—	.13

Non-Ferrous Metals

New York Markets

Cents per lb.

Copper, electrolytic.....	12.875
Aluminum, 98 to 99 per cent.....	19.00
Antimony, wholesale lots, Chinese and Japanese.....	5.00
Nickel, ordinary (ingot).....	36.00
Nickel, electrolytic.....	39.00
Nickel, electrolytic, resale.....	30.00-33.00
Monel metal, shot and blocks.....	32.00
Monel metal, ingots.....	35.00
Monel metal, sheet bars.....	38.00
Tin, 5-ton lots, Straits.....	30.75
Lead, New York, spot.....	5.00-5.25
Lead, E. St. Louis, spot.....	4.95-4.975
Zinc, spot, New York.....	5.40
Zinc, spot, E. St. Louis.....	4.90

OTHER METALS

Silver (commercial).....	oz.	\$0.70
Cadmium.....	lb.	1.00-1.10
Bismuth (500 lb. lots).....	lb.	2.00@2.10
Cobalt.....	lb.	3.00@3.25
Magnesium.....	lb.	1.15
Platinum.....	oz.	85.00@ 90.00
Iridium.....	oz.	160.00@170.00
Palladium.....	oz.	55.00@ 60.00
Mercury.....	75 lb.	51.00

OLD METALS—The following are the dealers' purchasing prices in cents per pound:

	New York	Current
Copper, heavy and crucible.....	10.25@10.50	
Copper, heavy and wire.....	10.00@10.25	
Copper, light and bottoms.....	7.75@ 8.25	
Lead, heavy.....	3.60@ 3.85	
Lead, tin.....	3.00@ 3.25	
Brass, heavy.....	4.50@ 4.75	
Brass, light.....	4.00@ 4.25	
No. 1 yellow brass turnings.....	4.00@ 4.25	
Zinc.....	2.25@ 2.50	

Structural Material

The following base prices per 100 lb. are for structural shapes 3 in. by $\frac{1}{2}$ in. and larger, and plates $\frac{1}{2}$ in. and heavier, from jobbers' warehouses in the cities named:

	New York*	Chicago
Structural shapes.....	\$2.48	\$2.38
Soft steel bars.....	2.38	2.28
Soft steel bar shapes.....	2.38	2.28
Soft steel bands.....	2.98	2.88
Plates, $\frac{1}{2}$ to 1 in. thick.....	2.48	2.38

*Add 15¢ per 100 lb. for trucking to Jersey City and 10¢ for delivery in New York and Brooklyn.

Industrial

Financial, Construction and Manufacturers' News

Construction and Operation

Alabama

EUFULA—The City Council will soon call for bids for the installation of a filtration plant in connection with the waterworks system. The Ludlow Engineering Co., Winston-Salem, N. C., is engineer.

Arkansas

FORT SMITH—The Twin City Glass Co., recently organized with a capital of \$100,000, has acquired local property comprising about 4 acres of land and will commence the immediate erection of a new plant for the manufacture of bottles, jars and other glass products. The main building will be about 50 x 100 ft., and will be supplemented by a number of smaller structures. A 15-ton glass tank will be installed. Harry Hart is president.

California

SAN FRANCISCO—The Magnolia Metal Co., Pacific Bldg., has taken bids for the erection of a new 1-story plant at Bryant and Sterling Sts., to cost about \$15,000. Work will be commenced at an early date. Dodge A. Reidy, Pacific Bldg., is architect.

ANTIOCH—The Paraffin Paper Box Co. is considering plans for the rebuilding of the portion of its plant destroyed by fire, April 5, with loss estimated at about \$30,000.

Florida

BAGDAD—The Bagdad Land & Lumber Co. has acquired property in Escambia County, Ala., and has preliminary plans under way for the erection of a new pine tar and turpentine extraction plant.

Georgia

CONCORD—Fire, April 8, destroyed a portion of the fertilizer works of R. H. Strickland, with loss estimated at about \$75,000, including section of feed milling plant and machinery in both structures.

Idaho

COEUR D'ALENE—Idaho Clays, Inc., recently organized, will hold in temporary abeyance the construction of its proposed new plant on property acquired on Twelfth St., between Indiana and Pennsylvania Aves., Hayden Lake district, to be used for the manufacture of pottery, tile and other burned clay products. It will be built at a later date. L. A. Spear is president.

Illinois

CHICAGO—The Globe Varnish Co., 5338 Justine St., has filed plans for the erection of a new 2-story plant, 75 x 100 ft., at 750-58 Loomis St., estimated to cost about \$35,000.

Indiana

NEW ALBANY—The Interstate Public Service Co., Indianapolis, will commence the immediate enlargement of its gas plant here, to include the construction of a new 300,000 cu.ft. gas holder. It is expected to double the present capacity.

WHITING—Fire, April 14, destroyed a portion of the plant of the Standard Oil Co., with loss estimated at about \$150,000, including a battery of stills, and other equipment.

INDIANAPOLIS—The Scoria Mfg. Co., operating at the former works of the Broad Ripple Fuel & Supply Co., has acquired a site at 63rd St. and the Monon Railroad for the erection of a new plant for the manufacture of hollow wall tile, cement blocks and kindred products. Plans will be prepared at an early date. The factory will be equipped for a daily output of 20,000 ft. of material, and is estimated to cost approximately \$50,000. E. L. Selva is president, and Charles T. Hornaday, vice-president and treasurer.

SEYMOUR—The Buhner Fertilizer Co. has tentative plans under consideration for the rebuilding of its plant, destroyed by fire, April 12, with loss estimated at \$50,000, including equipment.

Kentucky

ASHLAND—The Ashland Fire Brick Co., Winchester Ave. and 7th St., will make a number of improvements in its plant, including the remodeling of certain departments. Additional equipment will be installed. E. H. Gartrell is general manager.

LOUISVILLE—The Peaslee-Gaulbert Co., 413 West Main St., manufacturer of varnishes, wood finishes, etc., has plans under way for extensions and additions in its plant on 15th St., to cost about \$100,000. D. X. Murphy & Bro., Louisville Trust Bldg., are architects.

Louisiana

HAYNESVILLE—The Standard Oil Co. will make extensions in its local tankage and distributing plant, including seventy 55,000-bbl. capacity storage tanks and auxiliary equipment. Work will be commenced at once.

WASHINGTON—The Louisiana Concrete Products Co., recently organized with a capital of \$60,000, has acquired a local site and has plans in preparation for the erection of a plant for the manufacture of cement roofing tile and kindred products. Extensions will be made in the initial works at a later date for departments for the manufacture of bricks, blocks and other specialties. A. D. Alderson, Alexandria, La., is president; H. H. Holloway, Amite, La., is engineer.

Maryland

EASTON—The New Brick & Tile Co., recently formed with a capital of \$50,000, is completing plans and will soon break ground for the erection of a new local plant for the manufacture of brick, drain tile and other burned clay products. It is expected to have the works equipped and ready for operation some time in June. The company is headed by U. G. Ross, J. Fletcher Clark and Robert L. Kemp, all of Easton.

BALTIMORE—The Brooks Mexican Petroleum Co., 7 St. Paul St., has preliminary plans under way for the construction of a new oil storage and distributing plant on site in the Curtis Bay section, recently acquired. It will comprise a pier, tankage works, storage facilities for about 300,000 bbl., and auxiliary equipment, and is estimated to cost close to \$500,000. The company has been organized lately under state laws. W. B. Brooks is vice-president and general manager.

BALTIMORE—The Lasco Co., 206 South Sharp St., manufacturer of shellac and kindred products, is planning for extensions in its plant at 1117 Bush St., and will install equipment to more than double the present capacity. L. A. Stabler is president.

BALTIMORE—The Baltimore Brick Co., Maryland Trust Bldg., is completing the rebuilding of its plant No. 13 at East Baltimore, recently destroyed by fire, and will install machinery at an early date.

BALTIMORE—The Miller-Nelson Co., Belair Road, near Park Ave., will construct a new addition, 50 x 50 ft., at its cement products plant, to be equipped for molding and other service, estimated to cost about \$25,000.

Michigan

KALAMAZOO—The Kalamazoo Sanitary Mfg. Co., Factory St., has rejected all bids recently received for the erection of its proposed 2-story addition, 120 x 400 ft., and will hold the project in temporary abeyance. It is estimated to cost about \$200,000, including equipment.

MARYSVILLE—The Morton Salt Co. is rushing work on the three new factory buildings now in course of erection, and plans to have the structures equipped and ready for operation at an early date.

ESSEXVILLE—The Aetna Portland Cement Co., 412 Union Trust Bldg., Detroit, will commence foundation work at once for the different buildings to comprise its new plant

at Essexville. The main building will be 375 x 900 ft., to include grinding departments, coolers, etc.; three kilns will be constructed. The plant will have an initial output of about 3,000 bbl. of cement per day, and is estimated to cost in excess of \$750,000. Franklin R. Johnson is president; and O. J. Lingeman, secretary.

IONIA—The Michigan Porcelain Tile Co., recently organized, has taken bids on a general contract and will soon break ground for the erection of its proposed local plant, 1-story, 120 x 160 ft., estimated to cost about \$45,000. It will be equipped for the manufacture of tile and other burned clay products. Harry E. Kidder is general manager.

Mississippi

LUCEDALE—Allman Clark & Co. have plans under way for the erection of a new plant on local site, recently acquired, for the production of turpentine and other distilled products.

New York

RETSOF—The Retsof Mining Co. has plans nearing completion and will soon take bids for the construction of a local salt mining and manufacturing plant, to be 1- and 2-story, estimated to cost in excess of \$500,000, including equipment.

OAKFIELD—The extensions to be erected at the local plant of the United States Gypsum Co., 1170 Broadway, New York, will consist of two new buildings, 50 x 600 ft., and 50 x 100 ft. The first noted will be equipped for the production of gypsum wall-board products and the other structure for the manufacture of roofing tile and kindred specialties. Work will be commenced at an early date.

Oklahoma

SAPULPA—The Sapulpa Refining Co. is planning for the rebuilding of the tankage department and other portions of its local plant, destroyed by fire, April 4, with loss reported in excess of \$300,000, including equipment.

Pennsylvania

PHILADELPHIA—John Harrison, Jr., 21st and Race Sts., manufacturer of oil products, has awarded a contract to Barclay, White & Co., 1713 Sansom St., for the erection of a 1-story addition to his plant. Work will be commenced at once.

South Carolina

GAFFNEY—The McGraw Brick Co. is perfecting plans for the installation of new equipment at its plant for the manufacture of building tile and other burned clay products. The work will include the construction of a number of new kilns. It is proposed to develop an output of about 125 tons of tile per day, while the brick department will be arranged on a basis of 100,000 bricks per day. C. D. Meadows is secretary and general manager.

Tennessee

HARRIMAN—The Poland Mining Co., recently organized, has leased a portion of the local W. N. Poland, and will install a plant for the production of precious metals. Work will be commenced at an early date. Charles C. Jarvis heads the company; J. C. Williams is engineer.

Texas

MEXIA—The Texas-Mexia Refining Co., lately organized, will soon break ground for the construction of a new oil-refining plant on local site, with daily output of about 3,000 bbl. It is estimated to cost approximately \$500,000, including machinery.

COLEMAN—The City Council will soon commence the installation of a new filtration plant at the municipal waterworks. R. V. Wood is secretary.

ROCKDALE—The Empire Fuel Corporation, Dallas, operating lignite properties near Rockdale, is planning for the erection of a fuel carbonization and briquetting plant, with byproduct works for the manufacture of chemicals, dyes and kindred products from raw lignite. The company has recently increased its capital from \$1,000,000 to \$5,000,000, to provide funds for the plant. Adam H. Davidson is chairman of the board and treasurer; Roy R. McKee is secretary.

West Virginia

CHARLESTON—The Libbey-Owens Sheet Glass Co., Nicholas Bldg., Toledo, O., will soon commence the erection of additions to its local plant, including improvements in the present structures, estimated to cost close to \$200,000, including equipment.

Capital Increases, Etc.

THE NATIONAL PORTLAND CEMENT CO., Mount Pleasant, Mich., has filed notice of increase in capital from \$2,000,000 to \$61,400,000.

THE BROWN CO., Berlin, N. H., manufacturer of bleached sulphite pulp and paper, has arranged for a bond issue of \$3,000,000, the proceeds to be used for general operations and financing.

THE HUDSON OIL CO. OF DELAWARE, 135 Broadway, New York, N. Y., has filed notice of increase in capital from \$1,000,000 to \$3,000,000.

THE LITTLE FALLS PAPER CO., Little Falls, N. Y., has filed notice of dissolution under state laws.

THE RED BIRD OIL CO., Barboursville, Ky., has filed notice of increase in capital to \$50,000.

THE STANDARD MINING & CHEMICAL WORKS, 42 Broadway, New York, N. Y., has filed notice of increase in capital from \$75,000 to \$100,000.

A receiver has been appointed for the **WESTERN PENNSYLVANIA OIL CO.**, Butler, Pa.

A petition in bankruptcy has been filed against the **MURCOTT STEEL PRODUCTS CO.**, 776 Jamaica Ave., Brooklyn, N. Y.

THE UNION BAG & PAPER CO., Woolworth Bldg., New York, N. Y., has perfected plans for a bond issue to total \$3,000,000, to be used for general operations, financing, etc.

Louis B. Wehle has been appointed receiver in bankruptcy for the **ABORN STEEL CO.**, 22 Clark St., New York. The liabilities are said to be \$100,000, and assets \$75,000.

New Companies

THE NUDRO CO., Bayonne, N. J., has been incorporated with a capital of \$500,000, to manufacture chemicals and chemical by-products. The incorporators are G. F. and Robert L. Eaton, 115 East 5th St., Bayonne.

THE LINCOLN OIL CO., Boston, Mass., has been incorporated with a capital of \$50,000, to manufacture oil products. Joseph B. Shrago is president, and Charles Shrago, 51 McLellan St., Roxbury, Mass., treasurer.

H. C. COLLIER & SONS, INC., Binghamton, N. Y., has been incorporated with a capital of \$100,000, to manufacture chemicals, paints and kindred products. The incorporators are H. C., C. E. and C. R. Collier, all of Binghamton. The company is represented by Merchants, Waite & Waite, Binghamton.

THE DAWHOO CHEMICAL CO., Charleston, S. C., has been chartered under state laws to manufacture chemicals and chemical by-products. The incorporators are J. P. Matthews and E. Risher, both of Charleston.

THE UNITED CHEMICAL CO., Dallas, Tex., has been incorporated with a capital of \$30,000, to manufacture chemicals and affiliated products. The incorporators are William G. Carroll, G. T. and E. O. Cobb, both of Dallas.

THE EASTON FOUNDRY & MFG. CO., Easton, Pa., has been incorporated with a capital of \$75,000, to manufacture iron, steel and other metal castings. Raymond Kiser, Easton, is treasurer.

THE STEVENS ZODIPHRENT PRODUCTS CO., New York, has been incorporated with a capital of \$50,000, to manufacture soaps and kindred products. The incorporators are R. D. Elder, C. J. Wood and B. Clark, Jr. The company is represented by Fitch & Grant, 32 Nassau St., New York.

THE OKLAHOMA OIL CO., Columbus, O., has been incorporated under Delaware laws, with capital of \$8,100,000, to manufacture petroleum products. The incorporators are J. M. Lee, H. A. Evans and M. C. McShane, all of Columbus. The company is represented by Boyce & Magee, Dover, Del.

ROBERT W. LINTON, INC., Pawtucket, R. I., has been incorporated with a capital of \$60,000, to manufacture paper products. The incorporators are Walter C. Newell, Henry L. Burdick and Robert W. Linton, 750 York Ave., Pawtucket.

THE INDEPENDENT SHOPE BRICK CO., Waco, Tex., has been incorporated with a capital of \$60,000, to manufacture brick, tile and other burned clay products. The incorporators are B. W., G. V. and George Willig, all of Waco.

THE ANNABELLE MFG. CO., Syracuse, N. Y., has been incorporated with a capital of \$100,000, to manufacture chemicals, rubber products, etc. The incorporators are N. Vaeth, L. and G. Kallfelz, Syracuse. The company is represented by Shea & Crammins, University Block, Syracuse.

THE AMERICAN SUPPLY CO., Miami, Fla., has been chartered under state laws to manufacture fertilizer products. Frederick C. Gomer, Miami, is president; Charles R. Graham, Goulds, Fla., vice-president; and W. K. Walton, Homestead, Fla., secretary.

THE ISCOLITE CORP., East Orange, N. J., has been incorporated with a capital of \$200,000, to manufacture waterproofing materials. The incorporators are Albert R. Palmer, Leslie Reid and William H. O'Neill. The company is represented by the New Jersey Registration & Trust Co., 525 Main St., East Orange.

THE DU-RA ALUMINUM CO., Oklahoma City, Okla., has been incorporated with a capital of \$5,000, to manufacture aluminum and other metal products. The incorporators are J. F. and D. B. Boettcher, and O. J. Logan, Oklahoma City.

THE LITTLE FALLS PAPER CO., New Windsor, Orange County, N. Y., has been incorporated with a capital of \$250,000, to manufacture paper products. The incorporators are R. W. Spencer, S. L. Holden and L. J. White. The company is represented by Scott & Sneed, Newburgh, N. Y.

THE WILCO ASBESTOS MFG. CO., Brooklyn, N. Y., has been incorporated with a capital of \$10,000, to manufacture asbestos products. The incorporators are I. Wilkes, J. and B. Cohen, Brooklyn. The company is represented by H. D. Levy, 808 Broadway, Brooklyn.

THE MEADE RUBBER CO., Stoughton, Mass., has been incorporated with a capital of \$150,000, to manufacture rubber products. James Meade, Stoughton, is president and treasurer; Patrick H. Mahoney is vice-president.

THE SOUTHWEST CHEMICAL CO., Dallas, Tex., has been incorporated with a capital of \$10,000, to manufacture chemicals and chemical byproducts. The incorporators are J. William Morrow, M. C. Harris and J. F. Harrington, all of Dallas.

THE PEERLESS CONCRETE BRICK MFG. CO., INC., Philadelphia, Pa., has been incorporated with a capital of \$10,000, to manufacture cement brick and kindred products. J. B. McDevitt, 2004 North 25th St., Philadelphia, is treasurer.

THE SOUTHERN STATES OIL CORP., Dover, Del., has been incorporated under state laws with a capital of \$20,000,000, to manufacture petroleum products. The company is represented by Boyce & Magee, Dover.

THE HIGH TENSION INSULATOR CORP., Ballston Spa, N. Y., has been incorporated with a capital of \$50,000, to manufacture porcelain and other insulating products. The incorporators are R. H. Davidson, W. H. Namack and C. Branda. The company is represented by E. D. Eddy, Saratoga Springs, N. Y.

THE FORT DEARBORN DRUG & CHEMICAL CO., 225 North Michigan Ave., Chicago, Ill., has been incorporated with a capital of \$5,000, to manufacture chemicals and by-products, drugs, etc. The incorporators are Leonard Kaufman, Victor P. Houston and M. S. Greenbaum.

THE UNITED STATES CHEMICAL TEST CO., New York, N. Y., has been incorporated with a capital of \$5,000, to manufacture chemicals and chemical byproducts. The incorporators are F. Johnson, J. T. Fitzgerald and M. M. Klein. The company is represented by M. Eichner, 1545 Broadway, New York.

SANNER BROS., INC., Philadelphia, Pa., has been incorporated under Delaware laws with capital of \$100,000, to manufacture oil products. The incorporators are Celestin Sanner, Jules A. Rominger and M. L. O'Neill, Philadelphia. The company is represented by Amos A. Watson, Dover, Del.

THE NEILAN OIL & REFINING CO., Houston, Tex., has been incorporated with a capital of \$150,000, to manufacture refined petroleum products. The incorporators are P. A. Neilan, M. H. Gubbels and J. J. Chadil, all of Houston.

THE WHALERACK PRODUCTION CO., New York, N. Y., has been incorporated under Delaware laws with a capital of \$500,000, to manufacture oil products. The company is represented by the United States Corporation Co., 65 Cedar St., New York.

THE NITRAM PRODUCTS CO., Paterson, N. J., has been incorporated with a capital of \$200,000, to manufacture ferro-alloys. The incorporators are James S. Cudlipp, Carl C. and Ernest Greiner, 230 East 18th St., Paterson.

THE BLAYNE LABORATORIES, INC., 1442 Majestic Bldg., Detroit, Mich., has been incorporated with a capital of \$5,000, to manufacture chemical specialties. The incorporators are Walter H. Blome, Franklin S. Payne and E. H. Frye.

THE SAN MARCOS OIL CORP., New York, N. Y., has been incorporated with a capital of \$50,000, to manufacture oil products.

The incorporators are L. J. Lynch, F. A. Gill and D. T. Almond. The company is represented by W. F. Clare, 135 Broadway, New York.

THE CHAUTAUQUA PRODUCTS CO., Jamestown, N. Y., has been incorporated with a capital of \$10,000, to manufacture rubber specialties. The incorporators are A. W. Jackson, F. M. Garfield and W. A. Stoeltzing. The company is represented by Mott & Ottaway, Jamestown.

THE MID-STATES TANNING CO., 2417 Smith Ave., Detroit, Mich., has been incorporated with a capital of \$15,000, to manufacture leather products. The incorporators are James McAdoo, Jacob M. Feldsteen and James D. May.

THE ORTEX OIL CO., Beaumont, Tex., has been incorporated with a capital of \$50,000, to manufacture petroleum products. The incorporators are H. M. Higgins, E. L. Hall and O. H. Maschek, all of Beaumont.

THE PLASTIC PRODUCTS CO., New York, N. Y., has been incorporated with a capital of \$10,000, to manufacture composition paper products. The incorporators are M. Baumann, L. Rothbart and M. Symington. The company is represented by E. L. Brooks, 176 Broadway, New York.

THE PAINT SPECIALTIES CORP. OF NEW JERSEY, Jersey City, N. J., has been incorporated with a capital of \$15,000, to manufacture paints, varnishes, etc. The incorporators are John D. Craven, Walter J. Freund and George A. Wardell. The company is represented by Alfred K. Moe, 15 Exchange Place, Jersey City.

THE WOODISON-KELLEY CO., 7415 St. Aubin Ave., Detroit, Mich., has been incorporated with a capital of \$20,000, to manufacture chemical compounds, pastes, and kindred specialties. The incorporators are E. J. and J. C. Woodison, and Alfred D. Kelley.

THE NEW YORK GUMMED PAPER CO., New York, N. Y., has been incorporated with a capital of \$5,000, to manufacture paper products. The incorporators are E. D. and I. W. Ehrler, and A. F. Mayo. The company is represented by M. F. Miller, 350 Fulton St.

THE WOLVERINE CASTINGS CO., 405 East Ransom St., Kalamazoo, Mich., has been incorporated with a capital of \$10,000, to manufacture iron and other metal castings. The incorporators are William and Edward Korman, and Joseph W. Stohrer, Kalamazoo.

Industrial Developments

OIL—The Vacuum Oil Co. has adopted a full-time operating schedule at its plant at Olean, N. Y., replacing a half-time basis operative for a number of weeks past. About 400 men are affected.

THE INDIA-BURMA OILFIELDS CO., Rangoon, Burma, has opened its new oil-refining plant, recently completed, located about 15 miles from the city. The new refinery will run on a capacity basis for an indefinite period, using crude oil from the Yana and Padaupkin fields.

GLASS—The Hemingway Glass Co., Muncie, Ind., is increasing production at its plant, and expects to be on a close to normal basis at an early date.

THE OWENS BOTTLE CO., Toledo, O., has advanced production at its plants to about 80 per cent of capacity, and expects to increase the schedule at an early date. This same time a year ago the plants were running on a 25 per cent basis.

RUBBER—The Hydro-United Tire Co., Pottstown, Pa., has adopted a night shift at its plant, in addition to regular day production, under capacity operations.

THE MILLER RUBBER CO., Akron, O., manufacturer of automobile tires, is planning to make further increases in production at an early date.

THE MASON TIRE & RUBBER CO., Akron, O., is developing an expansion program providing for tire manufacture at practically double the regular output. It will be made effective at an early date.

CERAMIC—The Gill Clay Pot Co., Muncie, Ind., is increasing operations at its plant, giving employment to additional workers.

THE STAR CLAY CO., Mertztown, Pa., has resumed production at its works, following a shut-down for some time past.

PAPER—The American Writing Paper Co., Holyoke, Mass., has advanced production about 20 per cent at its different mills in Connecticut and Massachusetts since the first of the year.

According to an official statement of the American Paper & Pulp Association, mills in the industry throughout the country are

now running on an average total of 75 per cent of capacity, following the worst conditions, for 24 months past, experienced in this line for a generation.

METALS—The Anaconda Copper Co. has placed its High Ore and Anaconda properties, two of the largest producers in the Butte, Mont., district, in service, following an extended shut-down. The company is increasing production at its plants to a point nearer normal far exceeding earlier estimates.

The Utah Copper Co., Salt Lake City, Utah, has reopened a portion of its properties, the largest in this section, following a shut-down for about a year past. The company has also resumed active production at its Magna, Utah, plant.

The Phelps-Dodge Co., New York, is operating at its Copper Queen smelting plant, Arizona, after a shut-down of about 10 months.

The Utah-Apex Mining Co., Salt Lake City, Utah, has resumed operations at its plant, following a curtailment for about a year past.

The Calumet & Hecla Co., Inc., has resumed operations at a portion of its copper properties at Calumet, Mich., following an extended shut-down. It is proposed to develop production to a point of about 2,000 tons a day by May 1, with the resumption of the reclamation plant not later than this date, providing a monthly output of about 1,500,000 lb. of refined copper.

CEMENT—The Kansas City Cement Co., Cement City, Mo., is increasing production at its local plant and has added about 150 men to the working force.

The Atlas Portland Cement Co. is increasing the output at its plant at Northampton, Pa., and is placing subsidiary departments in operation after period of curtailment, including the local bag factory.

Cement shipments from the Lehigh Valley district of Pennsylvania are now exceeding 100 cars a day. The mills have been stocking up with bituminous coal for a number of weeks past, and now have close to a 3 months' supply on hand.

TIN PLATE—The N. & G. Taylor Co. has resumed operations at the open-hearth and bar mill departments at its plant at Cumberland, Md. The black plate and tinning departments are now running at about 90 per cent of normal.

IRON AND STEEL—The Easton Steel Co. has resumed operations at full capacity at one of the blast furnaces at its mills at Pottstown, Pa.

The Otis Steel Co., Cleveland, O., has advanced production to a full capacity, 100 per cent basis, at its steel mills.

The Republic Iron & Steel Co. is making repairs to a second furnace at its Thomas, Ala., plant, and will place the unit in service about May 1.

The Sloss-Sheffield Steel & Iron Co. has blown in another furnace at its North Birmingham, Ala., works, and will soon blow in the furnace at its Philadelphia mill at Florence, Ala.

The United States Steel Corp. has blown in another blast furnace at its Gary, Ind., plant, making 17 furnaces in active production at this works.

New Publications

BAKING TECHNOLOGY is the title of "a journal of applied science in baking," published monthly by the American Bakers' Association, 1135 Fullerton Ave., Chicago. The first number was issued in January. It sets a high editorial and professional standard and will undoubtedly prove to be a strong factor in raising the technology of the baking industry.

THE NATIONAL RESEARCH COUNCIL has published Bull. 16, dated December, 1921, on "Research Laboratories in Industrial Establishments of the United States," including consulting research laboratories.

U. S. GEOLOGICAL SURVEY PUBLICATIONS: I: 14, Gold, Silver, Copper, Lead and Zinc in Montana in 1920, by C. N. Gerry (Mineral Resources of the U. S., 1920, Part I), published Dec. 17, 1921; I: 18, Gold, Silver, Copper, Lead and Zinc in Utah in 1920, by V. C. Helges (Mineral Resources of the U. S., 1920, Part I), published Jan. 13, 1922; I: 19, Gold, Silver, Copper, Lead and Zinc in Nevada in 1920, by V. C. Helges (Mineral Resources of the U. S., 1920, Part I), published Jan. 13, 1922; I: 20, Gold, Silver, Copper, Lead and Zinc in Arizona in 1920, by V. C. Helges (Mineral Resources of the U. S., 1920, Part I), published Jan. 19, 1922; I: 21, Iron Ore, Pig Iron and Steel in 1920, by Ernest F. Burchard and Hubert W. Davis (Mineral Resources of the U. S., 1920, Part I), published Jan. 23, 1922; I: 22, Cobalt, Molybdenum, Nickel, Tantalum, Titanium, Tungsten, Radium, Ura-

nium and Vanadium in 1920, by Frank L. Hess (Mineral Resources of the U. S., 1920, Part I), published Feb. 20, 1922; I: 28, Tin in 1919, by Adolph Knopf and Bertrand L. Johnson (Mineral Resources of the U. S., 1919, Part I), published Jan. 26, 1922; II: 2, Salt, Bromine and Calcium Chloride in 1920, by Ralph W. Stone (Mineral Resources of the U. S., 1920, Part II), published Feb. 21, 1922; II: 24, Talc and Soapstone in 1920, by Edward Sampson (Mineral Resources of the U. S., 1920, Part II), published Jan. 20, 1922; II: 25, Gems and Precious Stones in 1920, by B. H. Stoddard (Mineral Resources of the U. S., 1920, Part II), published Dec. 29, 1921; II: 26, Concrete Stone and Concrete Blocks in 1920, by R. W. Stone (Mineral Resources of the U. S., 1920, Part II), published Jan. 12, 1922; II: 27, Stone in 1920, by G. F. Loughlin and A. T. Coons (Mineral Resources of the U. S., 1920, Part II), published March 6, 1922; II: 28, Cement in 1920, by Ernest F. Burchard (Mineral Resources of the U. S., 1920, Part II), published March 7, 1922.

NEW BUREAU OF STANDARDS PUBLICATIONS: Sci. Paper 425, Characteristic Soft X-Rays From Arcs in Gases and Vapors, by F. L. Mohler and Paul D. Foote; Sci. Paper 426, Thermal Expansion of Nickel, Monel Metal, Stainless Steel and Aluminum, by Wilmer H. Souder and Peter Hildner; Sci. Paper 429, Note on the Preparation of Mannose, by E. P. Clark; Tech. Paper 200, An Investigation of Oxyacetylene Welding and Cutting Blow-Pipes, With Especial Reference to Their Design, Safety and Economy in Operation, by Robert S. Johnston; Tech. Paper 203, Influence of Phosphorus Upon the Microstructure and Hardness of Low-Carbon, Open-Hearth Steels, by Edward C. Groesbeck; Tech. Paper 204, Cutting Fluids, by Eugene C. Bingham; Tech. Paper 205, Tensile Properties of Some Structural Alloy Steels at High Temperatures, by H. J. French; Tech. Paper 206, Effect of Heat-Treatment on the Mechanical Properties of 1 per Cent Carbon Steel, by H. J. French and W. George Johnson; Tech. Paper 207, Manufacture and Properties of Steel Plates Containing Zirconium and Other Elements, by George K. Burgess and Raymond W. Woodward; Tech. Paper 208, Weighing by Substitution, by C. A. Briggs and E. D. Gordon.

NEW BUREAU OF MINES PUBLICATIONS: Schedule 18, on "Procedure for Establishing a List of Permissible Carbon Monoxide Indicators," Tech. Paper 278, The Sugar-Tube Method of Determining Rock Dust in Air, by A. C. Fieldner, S. H. Katz and E. S. Longfellow; Tech. Paper 281, The Use of Electrolytes in the Purification and Preparation of Clay, by H. G. Schurecht; Tech. Paper 282, Analysis of Detonating and Priming Mixtures, by C. A. Taylor and W. H. Rinkenbach.

THE DIVISION OF THE STATE GEOLOGICAL SURVEY, State of Illinois, has issued Bull. 26 on "Coal Resources of District IV," by Gilbert H. Cady.

IN THE MODERN EXECUTIVE'S LIBRARY the H. E. Wilson Co., New York City, is entering into the field of business and industrial administration with a series of books similar in plan to its Handbook Series on current topics that are known in the educational field. This new series will include books of immediate practical value in every line of importance to business and industrial executives. Daniel Bloomfield, under whose general editorship the Modern Executive's Library will be built up, is a member of Bloomfield & Bloomfield, the Boston firm of lawyers and consultants in industrial relations. The Modern Executive's Library will be divided into Management Series and Industrial Relations Series. In the Management Series the following books are in preparation: Financial Incentives for Employees and Executives, by Daniel Bloomfield; Practical Psychology for Business Executives, by Lionel C. Edie; Personnel Problems, by Daniel Bloomfield. The following titles in the same series have been published to date: Employees' Magazines, by Peter F. O'Shea; Standard Practice in Personnel Work, by Eugene J. Bengt, with an introduction by Daniel Bloomfield. In the Industrial Relations Series the following volumes have been published: Employment Management, by Daniel Bloomfield, with introduction by Meyer Bloomfield; Problems of Labor, by Daniel Bloomfield, with introduction by Meyer Bloomfield; Modern Industrial Movements, by Daniel Bloomfield with introduction by Meyer Bloomfield.

SANITATION AND SEWAGE DISPOSAL FOR FARMSTEADS AND COUNTRY ESTATES. By William Paul Gerhard. Price 30 cents. Copies can be obtained at 17 West 42d St., New York City.

THE UNIVERSITY OF ILLINOIS has issued Bull. 127, on "Sound-Proof Partitions," by F. R. Watson, and Bull. 126, on "A Study of the Effect of Moisture Content Upon the Expansion and Contraction of Plain and Reinforced Concrete," by Torata Matsumoto.

Coming Meetings and Events

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE will hold a joint meeting with the Pacific Division of the association, on the occasion of the annual meeting of the latter, in Salt Lake City, June 22 to 24.

AMERICAN ASSOCIATION OF ENGINEERS will hold its eighth annual convention at Salt Lake City, Utah, June 4-6.

AMERICAN ELECTROCHEMICAL SOCIETY will hold its spring meeting in Baltimore, April 27, 28 and 29, 1922. Headquarters will be at the Emerson Hotel.

AMERICAN FOUNDRYMEN'S ASSOCIATION will hold its next convention and exhibit at Rochester, N. Y., during the week of June 5, 1922. Meetings will be held in the spring instead of in the fall as heretofore.

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS will hold its summer meeting at Niagara Falls, Canada, June 19 to 22. Headquarters will be at the Clifton Hotel.

AMERICAN LEATHER CHEMISTS ASSOCIATION will hold its nineteenth annual meeting at Bigwin Inn, Bigwin Island, in the Lake of Bays district, Ontario, Canada, on June 21, 22 and 23.

AMERICAN OIL CHEMISTS' SOCIETY will hold its annual meeting at the Grunewald Hotel, New Orleans, La., May 8 and 9.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS will hold its spring meeting at Atlanta, Ga., May 8-11.

AMERICAN SOCIETY FOR STEEL TREATING will hold a sectional meeting at the Bureau of Mines auditorium, Pittsburgh, Pa., on May 25 and 26. The International Steel Exposition and Convention of the society will be held in the General Motors Bldg., Detroit, Mich., Oct. 2 to 7.

AMERICAN SOCIETY FOR TESTING MATERIALS will hold its twenty-fifth annual meeting June 26 to July 1, at Atlantic City, N. J. Headquarters will be at the Chalfonte-Haddon Hall Hotel.

AMERICAN WELDING SOCIETY will hold its annual meeting April 26-29 at the Engineering Societies' Building, New York City.

ANNUAL SAFETY CONGRESS of the NATIONAL SAFETY COUNCIL will be held in Detroit, Mich., Aug. 28-Sept. 2.

CANADIAN INSTITUTE OF CHEMISTRY and the SOCIETY OF CHEMICAL INDUSTRY will hold their annual meetings in Ottawa May 15-17.

CERAMIC SOCIETY (London) is to have a foreign trip to Sweden and Denmark from May 27 to June 10.

INTERNATIONAL UNION OF PURE AND APPLIED CHEMISTRY will hold a meeting at Lyons, France, June 27 to 30.

IRON AND STEEL INSTITUTE (British) will hold its annual meeting on May 4 and 5 at the House of the Institution of Civil Engineers, Great George St., S. W., 1, London.

NATIONAL ASSOCIATION OF PURCHASING AGENTS EXPOSITION (the "Informashov") will be held in connection with the seventh annual convention of the association at Exposition Park, Rochester, N. Y., May 15 to 22.

NATIONAL COAL ASSOCIATION will hold its annual meeting at Congress Hall, Chicago, May 24-25.

NATIONAL EXPOSITION OF CHEMICAL INDUSTRIES (EIGHTH) will be held in New York Sept. 11-16.

NATIONAL EXPOSITION OF POWER AND MECHANICAL ENGINEERING will be held at the Grand Central Palace Dec. 7-13, with the exception of the intervening Sunday.

NATIONAL FERTILIZER ASSOCIATION will hold its twenty-ninth annual convention at the Greenbrier, White Sulphur Springs, W. Va., the week of June 12.

NEW JERSEY CHEMICAL SOCIETY will meet at Stettens Restaurant, 842 Broad St., Newark, N. J., the second Monday of every month.

SOCIETY OF INDUSTRIAL ENGINEERS will hold its national convention in Detroit, Mich., April 26-28.

STAMFORD CHEMICAL SOCIETY, Stamford, Conn., holds a meeting in the lecture room of the local high school on the fourth Monday of each month, except June, July, August and September.

The following meetings are scheduled to be held in Rumford Hall, the Chemists Club, New York: May 5—American Chemical Society, regular meeting; May 12—Société de Chimie Industrielle (in charge), American Chemical Society, Society of Chemical Industry, American Electrochemical Society, joint meeting; May 19—Society of Chemical Industry, regular meeting; June 9—American Chemical Society, regular meeting.